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Military Recruits

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13. ABSTRACT (Maximum 200 words) We studied healthy Marine recruits (controls), and recruits with exertional heat illness (EHI) or dilutional hyponatremia (patients) during basic training. With swallowed telemetry devices, we recorded core-temperature (T_{core}) of 380 male and 350 female recruits during training events with high incidence of EHI, to define norms for comparison with presenting T_{core} of EHI patients. With a computerized cognitive assessment battery we established norms for controls, and demonstrated acute impairment in 14 patients, showing that the battery distinguishes patients from controls. We collected baseline blood samples from 30 female and 35 male controls, and serial samples from 4 EHI patients for a pilot study of inflammatory responses in EHI. We collected copies of clinical records and pertinent training records on all identified EHI episodes in 1995-1996 (126 cases), and constructed a new computerized database which is congruent with clinical data forms in the patient records. These cases increase the total number of cases in the databases for epidemiological analyses and, particularly, the much smaller numbers of cases (only since 1993) for which published recruit training schedules are available to verify the training event during which each EHI episode occurred; and of female cases whose menstrual cycle phase was recorded.					
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FOREWORD

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C. Bruce Hagen 10/11/96
PI - Signature Date

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INTRODUCTION

An epidemiological study of exertional heat injury (EHI) in recruits undergoing basic training at Parris Island Marine Corps Recruit Depot (MCRD) has shown interesting differences between male and female recruits in the clinical presentation of EHI. Although incidence of EHI is similar in male and female recruits, 11% of male EHI patients, but <1% of female EHI patients are hospitalized. In non-hospitalized EHI patients, presenting rectal temperature is higher in the males, yet serum levels of enzymes indicating tissue injury are higher in the females (Table 1). These differences suggest that there may be differences between men and women in the pathogenesis of, and risk factors for, EHI.

In this recruit population, individual risk of EHI is strongly associated with time to complete the 1½-mile run in the first physical fitness test (PFT) during recruit training, and with body mass index (BMI) (weight/height^2) which correlates with obesity. In a recently published series (Gardner, Kark, Karnei, Sanborn, Gastaldo, Burr, and Wenger, 1996), recruits in the slowest quartile by run time had a 3-fold increase ($p < 10^{-5}$) in risk of EHI compared with recruits in the fastest quartile. Male recruits in the highest quartile for BMI had more than a 3-fold increase ($p < 10^{-5}$) in risk of EHI compared with recruits in the lowest quartile for BMI, and male recruits with both high BMI and long run times were at more than 6 times the risk of EHI as those who were thin and fast. Thus in men, at least, PFT run times and BMI are virtually independent predictors of risk of EHI. (Among female recruits, however, individuals in both the highest and the

Table 1

1990-1991 Female OP and Male OP and Hosp Heat Cases

4/11/94

		female	N = 34		male-op	N = 235		male-hosp	N = 44
	N	mean	std error	N	mean	std error	N	mean	std error
run dist (miles)	20	2.010	0.369	148	2.454	0.120	28	2.982	0.247
total days off	34	1.235	0.120	233	2.116	0.348	38	5.395	0.872
amnesia dur	9	7.778	1.690	76	12.316	2.371	25	39.280	11.197
max temp	33	101.585	0.286	235	102.227	0.125	44	105.005	0.475
field temp	16	102.344	0.377	179	102.660	0.114	32	105.734	0.367
worst neuro	28	7.893	0.342	202	7.500	0.124	43	5.535	0.380
max Na	27	140.481	0.763	209	141.795	0.302	44	144.614	0.591
min Na	27	139.778	0.690	209	140.111	0.313	44	137.318	0.598
1st Na	27	140.444	0.767	205	140.983	0.322	41	141.780	0.810
max K	27	4.081	0.078	209	4.425	0.038	44	4.632	0.082
min K	27	4.000	0.068	209	4.247	0.037	44	3.734	0.057
1st K	27	4.015	0.068	203	4.326	0.038	40	4.268	0.097
max Cl	27	104.630	0.922	208	103.659	0.348	44	112.682	3.022
min Cl	27	103.222	0.917	208	101.547	0.312	44	99.114	0.581
1st Cl	27	103.778	0.986	204	102.385	0.367	41	100.927	0.796
max HCO3	27	22.593	0.822	207	23.715	0.427	44	28.136	0.467
min HCO3	27	19.037	1.022	207	20.594	0.431	44	16.659	0.987
1st HCO3	27	19.481	1.114	199	21.678	0.495	39	16.821	1.127
max Gluc	27	105.148	7.757	208	103.438	2.496	44	130.045	5.647
min Gluc	27	93.185	5.449	208	92.159	1.979	44	79.023	1.932
1st Gluc	27	104.667	7.736	205	100.117	2.544	40	115.275	6.791
max BUN	27	13.904	0.813	208	17.271	0.370	44	18.923	0.973
1st BUN	27	13.789	0.818	200	16.829	0.388	41	18.610	1.029
max Creat	26	1.304	0.058	209	1.182	0.018	44	1.748	0.058
1st Creat	26	1.281	0.059	205	1.411	0.022	38	1.734	0.064
max Urlic Acid	19	5.558	0.322	171	7.987	0.157	40	10.680	0.559
1st Urlic Acid	18	5.606	0.336	139	8.029	0.186	24	10.775	0.543
max CPK	22	2215.318	1043.299	184	1570.995	212.178	40	6952.325	2261.435
1st CPK	21	2224.238	1095.530	152	1558.553	244.926	32	6256.344	2802.601
max SGOT	22	70.727	25.404	184	54.679	4.111	42	127.786	24.072
1st SGOT	21	71.381	26.646	148	54.926	4.524	29	82.897	20.588
max LDH	21	322.000	44.221	185	296.086	8.701	42	473.452	56.678
1st LDH	20	324.950	46.349	152	298.454	9.842	28	447.893	67.725
max WBC	27	8.848	0.752	204	9.408	0.245	43	13.923	2.176
1st WBC	27	8.700	0.704	201	9.285	0.233	41	13.439	2.265
max HBG	27	12.259	0.328	204	13.849	0.081	43	14.179	0.187
1st HBG	27	12.207	0.320	202	13.843	0.082	42	13.967	0.205
max HCT	27	38.693	1.028	205	43.550	0.274	43	43.088	0.624
1st HCT	27	38.563	1.004	203	43.433	0.359	42	42.438	0.646
min Plts	21	302.524	14.101	158	286.316	5.969	43	231.209	9.330
1st Plts	21	311.714	16.393	155	288.226	6.100	40	284.475	12.369
max Urine SG	19	1.014	0.002	124	1.015	0.001	40	1.019	0.001
min Urine SG	19	1.014	0.002	124	1.014	0.001	40	1.012	0.001
1st Urine SG	17	1.015	0.002	124	1.015	0.001	37	1.017	0.001
Sev Score	34	2.824	0.161	235	3.000	0.052	44	4.182	0.127
CNS Score	34	2.029	0.186	235	2.196	0.074	44	3.295	0.212
Deh Score	34	2.353	0.093	234	2.423	0.038	44	2.864	0.115
Renal Score	26	1.500	0.178	209	1.828	0.062	44	2.568	0.179
Lysis Score	22	1.864	0.266	184	1.918	0.078	40	2.750	0.234

lowest quartiles for BMI were at higher risk of EHI than those in the middle two quartiles.) Because of these relationships, it is a relatively simple matter to define and study subpopulations with substantially different individual risks of EHI.

The ratio of an individual's maximal rate of O_2 uptake ($\dot{V}O_{2max}$) to body weight (this ratio is sometimes called "relative $\dot{V}O_{2max}$ ") is an excellent predictor of his or her effectiveness in limiting increases in body core temperature (T_{core}) during exercise-heat stress (Davies, Brotherhood, and Zeidifard, 1976), and there is a strong inverse correlation between relative $\dot{V}O_{2max}$ and best run time over a given distance. Therefore one should expect PFT run time to be a good predictor of the risk of EHI. Because of the relation of BMI to obesity, and the relation between obesity and relative $\dot{V}O_{2max}$ (Buskirk and Taylor, 1957), one should also expect BMI to be a good predictor of relative $\dot{V}O_{2max}$ and thus of the risk of EHI. However, if BMI were related to individual EHI risk only as a predictor of $\dot{V}O_{2max}$, then BMI and PFT run time should not be independent predictors of EHI risk. The foregoing observations thus raise the possibility that obesity may increase individual risk of EHI through some mechanism other than an effect on the regulation of T_{core} .

The purposes of the work described in this report are:

(a) to characterize certain normal physiological and immunological responses to exercise-heat stress during basic training of Marine Corps recruits. The characterization will be based on measurements made on recruits who did not experience an episode of EHI associated with the event in which the measurements were obtained.

(b) to compare these normal responses in male recruits with those in female recruits, and to compare these normal responses with the corresponding responses in recruits presenting with an episode of EHI.

(c) to compare clinical features of EHI in male and female recruits.

Data collection and measurements performed during this reporting period include assessment of cognitive function with a customized subset of the Automated Neuropsychological Assessment Metrics (ANAM) Battery V3.11a; collection of blood samples to measure several cytokines and indices of leukocyte function; and body core temperature. The background for each of these three classes of measurements will be treated separately in the discussion that follows.

Assessment of Cognitive Function

Rectal temperature on presentation and degree of neurological impairment are probably the most widely recognized indices of severity of heat illness, and acute dramatic neurological changes are a defining characteristic of heatstroke. The prodromata of heatstroke and the manifestations of heat exhaustion and so-called "exertional heat injury" frequently include evidence of milder neurological dysfunction, such as agitation, impaired judgment, confusion, incoherent speech, ataxia, and unsteady gait. Anecdotal reports from drill instructors and clinical experience with EHI patients at Parris Island (J. A. Kark, personal communication) indicate that mild degrees of intellectual impairment (difficulty concentrating, slowed thinking) may persist for several days after apparent clinical recovery from

exertional heat illness. However, such intellectual impairment and its resolution following exertional heat illness have not previously been systematically studied to our knowledge.

Blood and Body Core Temperature Measurements

Historically, heat exhaustion and heatstroke have often been thought of as two entirely distinct clinical entities, of which heat exhaustion has been considered to be purely a disturbance of cardiovascular homeostasis, caused by impairment of venous return secondary to dehydration and peripheral pooling of venous blood, while heatstroke has been thought to be the result of a direct injurious effect of high temperatures on tissue. Many cases of heat exhaustion probably do represent relatively pure disturbance of cardiovascular homeostasis; however, other cases include evidence of cellular injury, such as elevated serum levels of various enzymes (Hubbard and Armstrong, 1988; cf. Table 1, based on recent experience at Parris Island). Moreover, there is no clear demarcation between heat exhaustion and heatstroke in practice, and many cases of heat illness could equally plausibly be classified either as severe heat exhaustion or as mild or early heatstroke. (Exertional heat injury, which appears in more recent literature on heat illness, may be a preferable diagnosis in many such cases.) It is likely, as Costrini et al. (Costrini, Pitt, Gustafson, and Uddin, 1979) and Hubbard (1979) have hypothesized, that heatstroke, exertional heat injury, and heat exhaustion (or at least those cases of heat exhaustion that involve more than a simple disturbance of cardiovascular homeostasis) represent parts of a continuum, sharing many of the same injurious processes.

Evidence has existed for some time that tissue temperature is not the only factor involved in the pathogenesis of heat illness. Hubbard (1979) analyzed exertional and non-exertional (classical) heatstroke, both in human patients and in an experimental rat model, and found that heatstroke may be produced by a less intense or shorter elevation of body core temperature in combination with heavy exercise, than in the absence of exercise. He therefore concluded that some non-thermal factor or factors related to exercise increase susceptibility to heatstroke. In addition, analysis of data on exertional heat illness at Parris Island during the years 1982-1991 showed a strong association between daily incidence of heat casualties and maximum wet-bulb globe temperature the day before occurrence, suggesting the operation of some sort of cumulative effect of heat stress—perhaps accumulation of some harmful substance or depletion of some beneficial substance.

Blood Measurements. It has not been demonstrated what the non-thermal factors involved in heat illness are, but published data point to certain promising candidates, in particular LPS (Bouchama, Parhar, El-Yazigi, Sheth, and Al-Sedairy, 1991; Butkow, Mitchell, Laburn, and Kenedi, 1984; Bynum, Brown, DuBose, Marsill, Leav, Pistole, Hamlet, LeMaire, and Caleb, 1978; Fine, 1975; Gathiram, Wells, Brock-Utne, and S. L. Gaffin, 1987; Graber, Reinhold, Breman, Harley, and Hennigar, 1971) and several cytokines (Bouchama et al, 1991; Bouchama, Al-Sedairy, Siddiqui, Shail, and Rezeig, 1993). Evidence for the involvement of these substances consists in demonstrations of their presence in blood and tissues of heatstroke patients and animals with experimentally-induced heatstroke; successful protection of

experimental animals against heatstroke by pretreatment with broad-spectrum antibiotics to reduce the intestinal flora, or with Anti-LPS immune serum; and the consistency of the effects of these substances with many of the clinical manifestations of heat illness. The source of the LPS is the gram-negative bacteria in the normal intestinal flora; and although this LPS is normally confined quite effectively within the intestines, certain stresses—including exercise (Bosenberg, Brock-Utne, Gaffin, Wells, and Blake, 1988), heat (Gathiram, Gaffin, Brock-Utne, and Wells, 1987; Gathiram, Wells, Raidoo, Brock-Utne, and Gaffin, 1988), and hypoxia (Gaffin, Brock-Utne, Zanotti, and Wells, 1986)—cause appearance of LPS in the systemic circulation. Since endotoxemia follows temporary intestinal ischemia produced by clamping the superior mesenteric artery (Gathiram, Gaffin, Wells, and Brock-Utne, 1986), it is likely that endotoxemia during exercise, heat stress, or hypoxia is a consequence of splanchnic vasoconstriction, which occurs as a cardiovascular homeostatic reflex (Rowell, 1974, 1983). It is likely that dehydration, by causing hypovolemia and compensatory splanchnic vasoconstriction, aggravates the endotoxemia associated with exercise and heat exposure, although we know of no study in which this hypothesis has been tested. In addition dehydration (Morimoto, Murakami, Ono, and Watanabe, 1986), muscle injury due to overexertion (Cannon, Medyani, Fielding, Fiatarone, Medyani, Farhangmehr, Orencole, Blumberg, and Evans, 1991), and perhaps other factors related to exercise and heat stress magnify the cytokine response to LPS.

We are aware of only three published studies that report levels of LPS or cytokines in the blood of human heat-illness

patients, and all three compare levels in patients to those in normal controls who have not recently undergone substantial exercise-heat stress. One of these (Graber et al., 1971) is a report of a single case of exertional heatstroke, and the other two studies (Bouchama et al., 1991, 1993) are of patients who, during the 1989 and 1990 pilgrimages to Mecca, contracted a mixed form of heatstroke (i.e., heatstroke which combined features of the classical and exertional forms, and which was associated with levels of exertion milder than those ordinarily associated with exertional heatstroke). The patients in the latter two studies had admission levels of LPS, TNF- α , IL-1 α , IL-1 β , IL-6, and interferon- γ that were significantly elevated compared to those of normal controls (Bouchama et al., 1991, 1993). The interpretation of these results in terms of the pathogenesis of heatstroke is not straightforward, since as noted above exercise, heat stress, and dehydration cause appearance of LPS in the systemic circulation, and since LPS, and perhaps intense exercise itself, elicit cytokine secretion, so that elevated amounts of these substances in patients' blood (compared to normal controls), may simply indicate recent exercise, heat stress, and dehydration, rather than a role for these substances in the pathogenesis of the patients' illness. Likewise, overexertion may cause skeletal muscle injury which is reflected in various serum enzyme levels and other chemistry measurements. However, the acute effect of basic training events on these measurements is not known, so that in attempting to account for the characteristic changes in hematological and clinical chemistry values that are associated with EHI, it is not possible to say to what extent these changes simply reflect recent intense exercise-

heat stress, and to what extent they represent part of the pathogenesis of EHI. Healthy recruits training under similar conditions—especially members of an EHI patient's training platoon who are training with the patient when the EHI episode begins—probably experience a very similar type and degree of exercise-heat stress to that experienced by the patient. Therefore measurements gotten on such recruits, under conditions as close as possible to those associated with the onset of the patient's heat illness, should be the best possible control measurements for interpreting corresponding measurements made on the patient, and for drawing inferences about the significance of these measurements for the pathogenesis of EHI.

If LPS and cytokines do have a role in the pathogenesis of EHI, one should expect Anti-LPS and naturally-occurring antagonists of cytokine action to protect against EHI, and perhaps to contribute to improved heat tolerance following heat acclimatization and physical training. High levels of Anti-LPS do appear to improve heat tolerance (Brock-Utne, Gaffin, Wells, Gathiram, Sohar, James, Morrell, and Norman, 1988), and may be increased by aerobic training (Bosenberg et al, 1988). In addition, Anti-LPS (Gaffin, 1988; Gaffin, Gathiram, Wells, and Brock-Utne, 1986; Pudifin, Lhoste, and Gaffin, 1985; Wells, Gaffin, Gregory, and Coovadia, 1987) and a naturally-occurring antagonist of IL-1 (Ohlsson, Björk, Bergenfeldt, Hageman, and Thompson, 1990) are therapeutically beneficial in gram-negative shock.

Core Temperature Measurements. The quantitative relation between core temperature and risk of occurrence of heat illness is not well understood. Part of the reason is that under

conditions in which heat illness is likely to occur, core temperature ordinarily is not measured in those who do not become sick. Moreover, as noted above, elevated core temperature is not the only factor involved in the pathogenesis of heat illness, so that core temperature by itself may be of limited value in predicting the likelihood of occurrence of heat illness. At any rate, there presently is no reliable basis for predicting the risk of heat illness based on level of core temperature, nor are there sufficient data to determine how valid a predictor core temperature, by itself, is. Dr. Richard Gonzalez, Chief of the Biophysics and Biomedical Modeling Division of USARIEM, has confirmed that the estimates of heat casualty rates in the USARIEM Heat Strain Model, which are computed from predicted core temperature, are based on anecdotal information and informed guesses.

Some authors have noted that high core temperatures during exercise are better tolerated by some individuals than by others, and under some conditions than under others. [Sawka, Young, Latzka, Neufer, Quigley, and Pandolf (1992) include a brief general discussion of the problem, and Montain, Sawka, Cadarette, Quigley, and McKay (1994) address the effect of clothing during exercise-heat stress in conditions where the rate of heat production exceeds the maximum possible rate of heat dissipation.] However, the effects of factors that alter tolerance to high core temperatures have not been well defined; and because of the scarcity of core temperature measurements in healthy persons under conditions in which heat illness is likely to occur, it is not known to what extent those who actually become heat casualties do so because they have higher core

temperatures than those who stay well, and to what extent they become heat casualties because they tolerate high core temperatures less well. As a corollary, therefore, the potential for improving tolerance to heat stress by means other than improving thermoregulation is not well understood.

Differences Between Men and Women in Responses to Exercise-heat Stress and Clinical Presentation of EHI

Little is known about women's susceptibility to EHI. The literature on EHI in women is extremely sparse, and exertional heatstroke in women is considered to be rare (Knochel, 1989). It is not known whether the apparent rarity of exertional heatstroke in women owes to their being less frequently exposed to situations in which exertional heatstroke is likely, to behavioral factors (e.g., a lesser willingness to push themselves beyond safe limits), or to biological differences in tolerance to heat stress. The best available information about heat tolerance of women is based on laboratory studies on small numbers of subjects [See Kolka (1992) for a recent review.] Women have been reported to be less tolerant than men to passive heating and to exercise-heat stress. However, when male and female subjects are matched for individual factors that are known to affect heat tolerance, such as anthropometric characteristics and maximal O₂ uptake, there is little difference in thermoregulatory responses during short-term (< 45 min) exercise-heat stress, at least when the women are in the follicular phase of the menstrual cycles (Stephenson and Kolka, 1988). During the luteal phase of the menstrual cycle, the thermoregulatory setpoint is shifted upward about 0.5°C, but otherwise the phase of the menstrual cycle seems

to have little effect on thermoregulatory responses and heat tolerance. However, during exercise of longer duration (> 60 min), heart rate and core temperature are higher than those prevailing at apparent steady state at the end of shorter periods of exercise at the same intensity. (The higher heart rate is part of a phenomenon known as "cardiovascular drift".) It is probably in association with such prolonged exercise-heat stress that EHI is most likely to develop, but little is known of the responses of women to such prolonged exercise-heat stress.

We are unaware of any published comparisons of men and women with respect to susceptibility to EHI or clinical presentation of EHI. However if, as recent work suggests, inflammatory/immunological processes are important in the pathogenesis of EHI, there may be important differences between men and women in heat tolerance and susceptibility to EHI, since reproductive hormones and the menstrual cycle are known to affect these processes. Data from our ongoing epidemiological study of EHI at Parris Island MCRD suggest that this may in fact be the case, since these data show differences between male and female recruits in the clinical presentation of EHI.

At Parris Island, our data show that male recruits and female recruits are almost equally likely to experience EHI (10% of recruits and 11% of EHI patients are female). However, 11% of male EHI patients are hospitalized, while female EHI patients are almost never hospitalized (Table 2): the only female EHI patient hospitalized during the years 1980-1995 had a co-existing sickle-cell crisis. The difference between male and female recruits in rates of hospitalization appears not to represent simply a difference in severity, but to be part of a more complex

Table 2. Number of Reported Cases of Heat Illness in U. S. Marine Recruits at PI MCRD, 1982-1991.
Number of Recruit Accessions and Estimated Number of Recruits in Training (in person-months),
1982-1991.

	YEAR										
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	TOTAL
All Cases											
Male	174	180	80	133	130	123	84	146	123	120	1293
Female	17	22	5	1	29	14	7	42	12	12	161
Total	191	202	85	134	159	137	91	188	135	132	1454
Hospitalized Cases											
Male	23	14	6	21	15	12	10	9	21	10	141
Female	0	0	0	0	0	0	0	0	0	0	0
total	23	14	6	21	15	12	10	9	21	10	141
Number of Recruit Accessions											
Male	22,283	21,333	22,256	19,346	19,851	19,287	18,118	17,909	18,228	15,877	194,488
Female	2,373	2,226	2,556	2,443	2,245	1,928	2,324	2,275	2,087	1,670	22,127
Estimated Recruit Population (person-months)											
Male	65,820	63,423	67,746	58,478	59,363	57,939	54,726	53,379	54,881	47,217	582,972
Female	7,310	6,726	7,567	7,357	6,782	5,845	6,953	6,870	6,178	5,100	66,688

difference in the clinical presentation of EHI. In cases occurring in 1990-1991, mean peak rectal temperature was 101.6°F in female patients (all non-hospitalized) and 102.7°F in non-hospitalized male patients; but mean peak serum levels of enzyme indicating cellular damage were all higher in females: CPK of 2215 vs 1571, AST of 71 vs 55, and LDH of 322 vs 297, suggesting that in women with EHI, a given level of rectal temperature may be associated with a more serious degree of tissue injury than in men, and that there may be quantitative differences in the pathogenesis between men and women. If so, it is likely that some features of EHI in female recruits vary with phase of the menstrual cycle. The recruit clinic (formally called the Branch Medical Clinic) at Parris Island began in 1993 to record date of last menstrual period for all female heat casualties, but the number of EHI cases in female recruits since then is not yet sufficient to show any pattern in those data.

BODY

METHODS

Volunteers

We recruited volunteers of both sexes from Marine recruits undergoing basic training at Parris Island MCRD. We administered swallowed temperature-sensing telemetry devices to approximately 1300 volunteers; collected blood samples from 30 female and 35 male controls and 4 EHI patients to measure several cytokines and indices of leukocyte function; and assessed cognitive function of 277 control recruits and 14 recruits who experienced a clinically significant episode of dilutional hyponatremia.

Experimental Design

Assessment of cognitive function. The Automated Neuropsychological Assessment Metrics (ANAM) battery (Reeves, Kane, Winter, Raynsford, and Pancella, 1993; Levinson and Reeves, 1994) is a computerized test designed for repeated measures testing. Tests of this sort are useful for neuropsychological evaluations because of such characteristics as standardization of administration, precision of measurement, immediate feedback on performance, and the ability to record subject response latencies too rapid to be measured otherwise (e.g., by a stopwatch). ANAM is the standard clinical subset of the Office of Military Performance Assessment Technology's (OMPAT) Tester's Workbench (TWB), and contains subsets of TWB tests specifically configured for use in neuropsychological assessment. The test battery used in the present study is a customized subset of ANAM 3.11a. Although there are published norms for performance of college graduates on ANAM 3.11a (Levinson and Reeves 1996), there are none for populations similar in education to USMC recruits, most of whom have completed high school or the equivalent. Therefore it was necessary to establish performance norms for healthy USMC recruits, against which to compare performance of patients.

Participants in the initial phase of the study consisted of 125 healthy volunteer USMC recruits (83 females, 42 males) who were undergoing basic training at the Parris Island MCRD near Beaufort, SC, and 14 of their classmates (patients) who were medically evaluated for dilutional hyponatremia. Mean age was 18.70 years (range: 17-26 years). All recruits are forbidden to use alcohol and tobacco during Basic Training. The patient group was similar to the normative group in age, gender, ethnicity,

previous education, and military experience. An additional group of 72 healthy male recruits was tested approximately one month later to increase the sample size and establish subsets of norms based on gender. Thus the total number of individuals on which the normative data presented in this report are based is 197 (83 females and 114 males).

All members of the normative group were tested in groups of five to ten on weekends following eight or more hours of rest/sleep. Testing was administered by an unobtrusive examiner in a quiet and thermoneutral classroom setting at the Naval Hospital at Beaufort, SC. Test sessions were held during the morning and the afternoon, and afternoon sessions were scheduled so as to allow subjects to eat lunch in the chow hall before testing. Several of the hyponatremia patients were tested in a quiet hospital room, and all were given the initial baseline test within five days of experiencing an episode of hyponatremia. The USMC subset of ANAM 3.11a was administered on IBM-compatible computers with VGA color graphics monitors. The response devices consisted of a Microsoft-computer mouse and the computer keyboard. The battery was administered once to each of the 125 "healthy" and 14 "patient" classmates during the first test session. All participants in the initial phase also completed a background questionnaire (Appendix B1 for males, or Appendix B2 for females), which asked questions about medical history and history of injuries and physical activity, to identify factors that might affect cognitive performance or susceptibility to EHI. Approximately one month later, 50 randomly selected females from the healthy group and 9 individuals from the patient group were re-tested. (Female controls were selected to be retested for

comparison with the patients who had experienced more serious clinical courses, all of which were female.) Both sessions included a brief orientation followed by administration of the full subtest. The additional group of 72 healthy male recruits was tested approximately one month later, in the same environment and under conditions similar to those of the initial groups.

(More recently an additional 80 males were tested twice each, at intervals of 2 hours, 1 week, or 7 weeks, to establish norms for test-retest performance. Results of their testing have not yet been analyzed and therefore are not presented in this report.)

The USMC subset of ANAM 3.11a tasks included the Stanford Sleepiness Scale (S.P.; measured both at commencement and at end of a session), Mood Scale-2 (MOO), Code Substitution (visual search, immediate recall, and delayed recall: CDS, CDI, CDD), Sternberg Memory Search (6 letter memory sets: ST6), Running Memory Continuous Performance Tasks (CPT-80 and CPT-160), Digit Symbol (DGS), Logical Reasoning (LRS), Matching to Sample (MSP), Mathematical Processing (MTH), Spatial Processing (SPD), and Simple Reaction Time Tasks (SRT1,2,3). These subtests of ANAM have been described previously (Reeves and Winter, 1992; Levinson and Reeves, 1994). Each session required approximately 60 minutes, and all volunteers were thanked for their participation at conclusion of the sessions.

The ANAM data files were first consolidated in a computerized spreadsheet and then inspected for completeness and invalid data. Invalid data were defined as "premature responses" which occurred in less than 100 ms, and/or data characterized by an inordinate number of lapses, which indicated that the participant did not understand the instructions for a test prior

to administration. This initial screening resulted in unequal numbers of participants associated with each test, but it ensured that the preliminary data presented here were derived from complete and valid test administrations. The significance of differences between means of performance scores of the patient group and those of the normative group was assessed via one-sample t-tests.

Collection of blood samples. We collected blood samples to assess immune responses in 30 female and 35 male controls and 4 patients. Control blood samples were collected from rested recruits during in-processing, early in their first week at Parris Island MCRD, before the beginning of training. Blood samples from EHI patients were collected on the patient's arrival at the clinic and 4 hours and 24 hours later. Each blood sample consisted of two 10-ml heparinized Vacutainer® tubes of blood, and in addition a 10-ml purple-topped Vacutainer® tube of blood was collected for hematocrit, hemoglobin, white cell count, and differential. The heparinized tubes were put into melting crushed ice for no more than 30 min, and centrifuged. Plasma and the buffy coat from each sample were separated, frozen, and stored at -70°C for later analysis at USARIEM (see below).

Continuous recording of body core temperature. With some training platoons, we measured volunteers' core temperatures on only one occasion, whereas with others we obtained measurements on several occasions, at different stages of training. On enrollment in this phase of the study, each volunteer completed a background questionnaire (first part of Appendix B3 for males, or of Appendix B4 for females). These questionnaires ask about factors that may account for individual

differences in core-temperature responses to exercise, including previous occupation, physical activity level, medical history, and current medications.

We measured body core temperature with ingested CorTemp® (HTI Technologies, Inc., St. Petersburg, FL) telemetric temperature sensors. The temperature signal is transmitted via an antenna worn on the volunteer's trunk to a small data recorder worn on the belt. While the sensor is in the stomach, it is affected by the temperature of anything that the volunteer ingests (e.g., a drink of cold water). Therefore sensors were administered at approximately 8:00 p.m. the evening before we intended to collect data, so that they would be in the small intestine when data collection began.

We chose the training days on which to record core temperature so as to include preferentially those training events associated with high rates of EHI (chiefly distance runs, but including also some load-carrying marches), and also so as to allow comparison of similar events that are repeated at different stages of training. On the training days when we recorded core temperature, each volunteer completed a short questionnaire (second part of Appendix B3 or B4) to give information about recent fluid consumption, amount of sleep the night before, medical history during the previous two weeks and, for each female recruit, the date of her last menstrual period. In addition, skin-fold thicknesses was measured at three sites, to estimate body fat content. We recorded temperature continuously for the duration of the day's chief physical training session, approximately 3 hours except when a road march was included, on which occasions data collection lasted longer.

Collection and organization of clinical data on EHI patients. For all identified EHI episodes during 1995 and 1996 (approximately 126 cases), we made photocopies of all pages in the patient charts (including follow-up clinic visits) that pertain to these cases, all clinical laboratory reports, and all pertinent Recruit Incident Reports (RIRs), which are filed by the Drill Instructors. The Branch Medical Clinic uses standard clinical data forms, and obtains a standard panel of laboratory evaluation, for suspected EHI patients. These forms and the standard panel were originally designed for an epidemiological study of EHI, and continue in use, with some modifications, for the present study. These forms are structured so as to record circumstances of the onset of the episode of EHI and clinical information including treatment and serial vital signs and neurological evaluation, in a standard format. Weather data are obtained from hourly measurements of WBGT made at Parris Island MCRD during the hot season, and from meteorological data recorded at the nearby Marine Corps Air Station at Beaufort, SC. The training activity at the onset of EHI episode is obtained from the clinical data forms and the RIRs, and confirmed using the applicable published recruit training schedules.

We constructed a new linked multi-relational database, which is based on EpiInfo software, and is congruent with the clinical data forms currently used for suspected EHI patients at the Branch Medical Clinic. (This database replaces a previous database that was constructed in 1991-1992 for the project "Heat injury among Marine recruits" under the direction of J. W. Gardner, COL, MC, in the Department of Preventive Medicine and Biometry, USUHS. The previous database is not congruent with the

clinical data forms in use since 1993.) Approximately 50 of the 1995-1996 EHI cases had been reviewed and entered into the new database when this report was prepared.

Specific measurements and techniques. Analyses of the blood samples obtained from EHI patients and healthy controls will be carried out by J. S. Kennedy, MAJ, MC or his technician in MAJ Kennedy's laboratory at USARIEM. Plasma in these samples will be assayed for inflammatory cytokines interleukin (IL)-1 β , tumor necrosis factor (TNF), and IL-6. The anti-inflammatory cytokines IL-1 receptor antagonist (IL-1Ra) and soluble cytokine and cell adhesion receptors will be assayed from plasma to assess the balance between pro-inflammatory and anti-inflammatory host response during heat illness. All analyses on plasma will be performed using commercial kits. To elucidate mechanisms by which host inflammatory response to heat illness is modulated, we will harvest messenger RNA from peripheral leukocytes (contained in the buffy coat) and analyze for gene products that regulate the inflammatory response. By use of reverse transcription-polymerase chain reaction we will determine mRNA levels for IL-1, IL-2, γ -interferon, and markers of gene regulation such as c-fos, c-jun, and AP-1.

RESULTS

Assessment of Cognitive Function

Mean scores on the Stanford Sleepiness Scale were 3-4 and 3-5 for the first and second sessions, indicating an average level of wakefulness at the start of each session and a slightly lower

level at the end of the session. Analysis of the summary data on the Moodscale is incomplete and will not be presented here.

Means, standard deviations, and related summary data for the 197 healthy USMC recruits obtained during the initial test session are presented in Table 3. Tables 4 and 5 present similar data for the 83 females and 114 males, respectively. No gender differences were apparent for either accuracy or efficiency of performance on any of the tasks. Data for the retest session are presented in Table 6. Accuracy scores were high on all tasks during both sessions, and efficiency scores were comparable to those obtained using ANAM 1.0 by Levinson and Reeves (1994).

Means and standard deviations for accuracy and efficiency of performance during both the initial test session and the retest for the patient group of 14 USMC trainees who experienced hyponatremia are presented in Table 7. (Although the headings for Tables 7 and 8 refer to "Heat Stress Results", the data are, in fact, those for the hyponatremia patients.) The initial session occurred within 24 hours of the onset of hyponatremia, while the retest was conducted during the following 14 weeks. During the initial session, mean accuracy scores were significantly below normal on only 3 tasks, while mean efficiency scores were significantly below normal on 8 tasks.

The initial and retest scores on all tasks for one of the trainees experiencing hyponatremia, together with a neuropsychological evaluation summary note, are presented in Table 8. Her scores are fairly typical of the group as a whole. The clinical significance of her performance was determined by comparing her scores to those of the healthy, normative group. This was accomplished by converting the raw scores to Z-scores

Table 3
ANAM-USMC Normative Data
Summary Statistics (n = 197)

ANAM-USMC Norms (n = 197) Subject Demographics Session 1 - 1		
	Age	Education
MEAN	19	12
STD DEV	2	1
MIN	17	12
MAX	28	17
MEDIAN	18	12

ANAM-USMC Norms (n = 196) STANFORD SLEEPSCALE Session 1-1		
	Score	Time (ms)
Mean	3	32929
SD	1	14952
Min.	1	3592
Max.	6	133821
Median	2	29638

ANAM-USMC Norms (n = 186) STANFORD SLEEPSCALE Session 1-2		
	Score	Time (ms)
Mean	4	13233
SD	1	9884
Min.	1	1547
Max.	6	67670
Median	3	10615

ANAM-USMC Norms (n = 186) Simple Reaction Time (Session 1 - 1) Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	MDN All
MEAN	0	276	84	222	100	281
STD DEV	0	40	71	31	0	44
MIN	0	202	16	149	100	192
MAX	0	403	417	297	100	454
MEDIAN	0	272	60	221	100	283

ANAM-USMC Norms (n = 186) Simple Reaction Time (Session 1 - 2) Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	MDN All
MEAN	0	294	101	210	100	263
STD DEV	0	53	103	34	0	29
MIN	0	203	19	120	100	205
MAX	0	499	744	296	100	367
MEDIAN	0	286	70	210	100	259

ANAM-USMC Norms (n = 179) Simple Reaction Time (Session 1 - 3) Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	MDN All
MEAN	0	275	71	223	100	247
STD DEV	0	40	39	32	0	34
MIN	0	200	16	149	95	186
MAX	1	403	258	299	100	386
MEDIAN	0	273	64	220	100	237

ANAM-USMC Norms (n = 80) Continuous Performance Task - Running Memory (CPT80) Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	MDN All
MEAN	1	620	181	91	94	599
STD DEV	2	84	34	14	4	90
MIN	0	429	87	59	81	395
MAX	8	858	274	126	100	879
MEDIAN	1	614	181	92	94	598

ANAM-USMC Norms (n = 84) Continuous Performance Task - Running Memory (CPT160) Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	MDN All
MEAN	1	603	193	96	95	571
STD DEV	1	101	50	16	4	98
MIN	0	457	95	59	82	421
MAX	8	915	302	126	100	907
MEDIAN	0	579	187	97	95	554

Table 3
ANAM-USMC Normative Data
Summary Statistics (n = 197)

ANAM-USMC Norms (n = 191)							
Digit Set Comparison							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	1564	686	92	36	1393	1424
STD DEV	0	330	271	7	9	304	317
MIN	0	781	258	67	18	718	773
MAX	2	2305	1690	100	72	2233	2233
MEDIAN	0	1542	634	92	36	1386	1417

ANAM-USMC Norms (n = 155)							
Logical Relations (Symbols)							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	2342	859	87	24	2164	2184
STD DEV	0	603	474	7	6	548	544
MIN	0	1271	198	69	10	1240	1255
MAX	2	4707	2580	100	40	4592	4613
MEDIAN	0	2217	731	88	23	2083	2121

ANAM-USMC Norms (n = 187)							
Mathematical Processing							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	2920	1119	93	21	2674	N/A
STD DEV	0	793	532	8	6	714	N/A
MIN	0	1353	267	67	8	1260	N/A
MAX	1	6554	3030	100	41	5159	N/A
MEDIAN	0	2814	1005	93	20	2608	N/A

ANAM-USMC Norms (n = 185)							
Memory Search (Sternberg - 6)							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	1114	544	91	51	951	N/A
STD DEV	0	293	309	8	13	225	N/A
MIN	0	721	135	67	17	615	N/A
MAX	0	2371	1695	100	81	1942	N/A
MEDIAN	0	1014	457	93	52	887	N/A

ANAM-USMC Norms (n = 170)							
Spatial Processing (Simultaneous)							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	2484	877	90	24	2331	N/A
STD DEV	0	746	592	9	7	676	N/A
MIN	0	1217	243	60	9	1177	N/A
MAX	0	5737	3567	100	46	4922	N/A
MEDIAN	0	2339	713	93	24	2246	N/A

ANAM-USMC Norms (n = 182)							
Matching to Sample							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	1563	655	91	37	1390	1392
STD DEV	0	436	392	8	12	325	340
MIN	0	662	175	67	13	629	618
MAX	1	2983	2284	100	84	2321	2404
MEDIAN	0	1517	587	93	36	1358	1363

Table 3
ANAM-USMC Normative Data
Summary Statistics (n = 197)

ANAM-USMC Norms (n = 193) Code Substitution (Visual Scanning) Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN All
MEAN	0	1205	452	96	51	1097
STD DEV	0	299	212	3	12	255
MIN	0	496	155	81	20	366
MAX	1	2936	1791	100	118	2259
MEDIAN	0	1158	405	97	50	1057

ANAM-USMC Norms (n = 196) Code Substitution (Immediate Recall) Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN All
MEAN	0	1282	528	93	46	1132
STD DEV	0	338	348	9	13	234
MIN	0	413	136	50	19	346
MAX	2	2393	1841	100	85	1800
MEDIAN	0	1218	425	94	46	1082

ANAM-USMC Norms (n = 196) Code Substitution (Delayed Recall) Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN All
MEAN	0	1237	551	90	47	1077
STD DEV	0	368	459	11	14	252
MIN	0	597	84	50	15	421
MAX	2	3033	2930	100	81	2658
MEDIAN	0	1146	409	94	47	1017

Table 4
ANAM-USMC Normative Data
Female Data (n = 83)

ANAM-USMC Females (n = 83) Subject Demographics Session 1 - 1		
MEAN	Age	Education
STD DEV	19	13
MIN	2	1
MAX	17	12
MEDIAN	26	17
	18	12

ANAM-USMC Females (n = 81) STANFORD SLEEPSCALE Session 1-1		
Mean	Score	Time (ms)
SD	3	32929
Min.	1	14952
Max.	1	3592
Median	6	133821
	2	29638

ANAM-USMC Females (n = 78) STANFORD SLEEPSCALE Session 1-2		
Mean	Score	Time (ms)
SD	4	13447
Min.	1	10615
Max.	1	1547
Median	6	67670
	4	10516

ANAM-USMC Female Normative Data (n = 78) Simple Reaction Time (Session 1 - 1) Summary Statistics for Specified Measures						
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	280	93	219	312	312
STD DEV	0	46	86	33	39	39
MIN	0	211	16	149	277	277
MAX	0	403	416	285	454	454
MEDIAN	0	272	60	221	299	299

ANAM-USMC Female Normative Data (n = 79) Simple Reaction Time (Session 1 - 2) Summary Statistics for Specified Measures						
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	295	86	210	260	260
STD DEV	0	60	94	35	9	9
MIN	0	215	19	120	245	245
MAX	0	499	656	279	276	276
MEDIAN	0	280	54	214	259	259

ANAM-USMC Female Normative Data (n = 78) Simple Reaction Time (Session 1 - 3) Summary Statistics for Specified Measures						
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	280	69	218	232	232
STD DEV	0	38	36	28	21	21
MIN	0	215	16	149	205	205
MAX	0	403	217	280	386	386
MEDIAN	0	278	65	216	231	231

ANAM-USMC Female Normative Data (n = 28) Continuous Performance Task - Running Memory (CPT80) Summary Statistics for Specified Measures						
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	1	614	187	91	599	587
STD DEV	2	68	29	11	73	72
MIN	0	490	115	75	470	470
MAX	8	732	239	113	727	722
MEDIAN	1	614	190	89	604	585

ANAM-USMC Female Normative Data (n = 28) Continuous Performance Task - Running Memory (CPT160) Summary Statistics for Specified Measures						
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	1	597	184	98	571	569
STD DEV	2	97	49	15	97	98
MIN	0	459	105	59	429	421
MAX	8	863	281	123	850	848
MEDIAN	0	571	173	100	543	541

Table 4
ANAM-USMC Normative Data
Female Data (n = 83)

ANAM-USMC Female Normative Data (n = 80)							
Digit Set Comparison							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	1595	724	92	35	1414	1443
STD DEV	0	298	274	6	8	278	288
MIN	0	919	258	75	20	809	809
MAX	2	2271	1461	100	51	2113	2128
MEDIAN	0	1581	679	92	34	1431	1442

ANAM-USMC Female Normative Data (n = 82)							
Mathematical Processing							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	2858	1068	94	21	2611	N/A
STD DEV	0	794	577	8	6	685	N/A
MIN	0	1718	369	67	9	1656	N/A
MAX	1	5003	3030	100	35	4761	N/A
MEDIAN	0	2685	911	100	21	2451	N/A

ANAM-USMC Female Normative Data (n = 67)							
Spatial Processing (Simultaneous)							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	2482	846	90	23	2354	N/A
STD DEV	0	639	481	10	7	617	N/A
MIN	0	1457	243	67	9	1431	N/A
MAX	0	4352	2899	100	36	3762	N/A
MEDIAN	0	2357	741	93	22	2284	N/A

ANAM-USMC Female Normative Data (n = 69)							
Logical Relations (Symbols)							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	2249	789	88	25	2105	2121
STD DEV	0	602	442	6	6	535	514
MIN	0	1271	226	69	12	1240	1255
MAX	2	4032	2391	100	38	3438	3438
MEDIAN	0	2131	645	88	24	2002	2041

ANAM-USMC Female Normative Data (n = 78)							
Memory Search (Sternberg - 6)							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	1055	495	93	55	900	N/A
STD DEV	0	270	291	7	13	201	N/A
MIN	0	722	135	67	17	615	N/A
MAX	0	2332	1541	100	81	1917	N/A
MEDIAN	0	989	441	97	57	850	N/A

ANAM-USMC Female Normative Data (n = 78)							
Matching to Sample							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	1575	670	90	36	1389	1402
STD DEV	0	378	364	8	11	283	303
MIN	0	752	191	67	17	694	678
MAX	0	2422	1954	100	75	2125	2159
MEDIAN	0	1509	607	93	35	1383	1377

Table 4
ANAM-USMC Normative Data
Female Data (n = 83)

ANAM-USMC Female Normative Data (n = 83)						
Code Substitution (Visual Scanning)						
Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	Thruput MDN Corr MDN All
MEAN	0	1162	441	441	96	53 1062 1061
STD DEV	0	322	251	251	3	13 262 262
MIN	0	496	174	174	81	20 366 360
MAX	1	2936	1791	1791	100	118 2233 2259
MEDIAN	0	1108	384	384	97	53 1035 1038

ANAM-USMC Female Normative Data (n = 83)						
Code Substitution (Immediate Recall)						
Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	Thruput MDN Corr MDN All
MEAN	0	1257	518	518	93	47 1112 1112
STD DEV	0	337	319	319	8	12 252 260
MIN	0	413	136	136	50	24 346 324
MAX	1	2238	1542	1542	100	85 1787 1893
MEDIAN	0	1169	434	434	94	48 1080 1065

ANAM-USMC Female Normative Data (n = 82)						
Code Substitution (Delayed Recall)						
Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	Thruput MDN Corr MDN All
MEAN	0	1186	467	467	91	49 1058 1062
STD DEV	0	326	345	345	9	12 277 279
MIN	0	597	84	84	50	20 421 387
MAX	0	2720	1880	1880	100	74 2658 2658
MEDIAN	0	1119	364	364	94	49 1012 1013

Table 5
ANAM-USMC Normative Data
Male Data (n = 114)

ANAM-USMC Males (n = 114) Subject Demographics Session 1 - 1			
Age	Education		
MEAN	19	13	
STD DEV	2	1	
MIN	17	12	
MAX	26	17	
MEDIAN	18	12	

ANAM-USMC Males (n = 114) STANFORD SLEEPSCALE Session 1-1			
Score	Time (ms)		
Mean	2	30631	
SD	1	16420	
Min.	1	8558	
Max.	7	110538	
Median	2	26708	

ANAM-USMC Males (n = 108) STANFORD SLEEPSCALE Session 1-2			
Score	Time (ms)		
Mean	3	13001	
SD	2	7969	
Min.	1	2612	
Max.	7	46812	
Median	3	10815	

ANAM-USMC Male Normative Data (n = 108) Simple Reaction Time (Session 1 - 1) Summary Statistics for Specified Measures							
Lapses	Mean RT	SD	MRT	% Acc	Thruput	MDN	Corr
MEAN	0	272	78	100	224	258	258
STD DEV	0	36	58	0	30	32	32
MIN	0	202	20	100	162	192	192
MAX	0	371	417	100	297	336	336
MEDIAN	0	272	59	100	221	256	256

ANAM-USMC Male Normative Data (n = 107) Simple Reaction Time (Session 1 - 2) Summary Statistics for Specified Measures							
Lapses	Mean RT	SD	MRT	% Acc	Thruput	MDN	Corr
MEAN	0	293	112	100	210	266	266
STD DEV	0	47	108	0	33	37	37
MIN	0	203	24	100	143	205	205
MAX	0	419	744	100	296	367	367
MEDIAN	0	287	84	100	209	260	260

ANAM-USMC Male Normative Data (n = 101) Simple Reaction Time (Session 1 - 3) Summary Statistics for Specified Measures							
Lapses	Mean RT	SD	MRT	% Acc	Thruput	MDN	Corr
MEAN	0	271	70	100	227	259	259
STD DEV	0	40	37	0	33	38	38
MIN	0	200	22	95	166	186	186
MAX	1	362	251	100	299	347	347
MEDIAN	0	267	61	100	225	255	255

ANAM-USMC Male Normative Data (n = 52) Continuous Performance Task - Running Memory (CPT80) Summary Statistics for Specified Measures							
Lapses	Mean RT	SD	MRT	% Acc	Thruput	MDN	Corr
MEAN	1	623	178	94	91	610	605
STD DEV	2	92	36	4	15	102	99
MIN	0	429	87	81	59	389	395
MAX	8	858	274	99	126	882	879
MEDIAN	1	612	180	95	92	602	601

ANAM-USMC Male Normative Data (n = 56) Continuous Performance Task - Running Memory (CPT160) Summary Statistics for Specified Measures							
Lapses	Mean RT	SD	MRT	% Acc	Thruput	MDN	Corr
MEAN	1	607	197	95	96	574	572
STD DEV	1	104	50	4	16	100	100
MIN	0	457	95	82	59	440	437
MAX	5	915	302	100	126	907	907
MEDIAN	0	586	193	96	96	555	555

Table 5
ANAM-USMC Normative Data
Male Data (n = 114)

ANAM-USMC Male Normative Data (n = 111)							
Digit Set Comparison							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	1541	658	92	37	1378	1410
STD DEV	0	351	267	8	10	322	337
MIN	0	781	258	67	16	718	773
MAX	2	2305	1690	100	72	2233	2233
MEDIAN	0	1526	610	92	36	1373	1373

ANAM-USMC Male Normative Data (n = 105)							
Mathematical Processing							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	2968	1159	93	20	2723	N/A
STD DEV	0	793	494	7	6	735	N/A
MIN	0	1353	267	67	8	1260	N/A
MAX	1	6554	2979	100	41	5159	N/A
MEDIAN	0	2875	1017	93	19	2672	N/A

ANAM-USMC Male Normative Data (n = 103)							
Spatial Processing (Simultaneous)							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	2485	897	90	24	2315	N/A
STD DEV	0	811	656	8	7	714	N/A
MIN	0	1217	265	60	10	1177	N/A
MAX	0	5737	3567	100	46	4922	N/A
MEDIAN	0	2305	702	93	24	2200	N/A

ANAM-USMC Male Normative Data (n = 86)							
Logical Relations (Symbols)							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	2416	915	87	23	2211	2234
STD DEV	0	596	493	7	6	557	564
MIN	0	1311	198	69	10	1336	1336
MAX	1	4707	2580	94	40	4592	4613
MEDIAN	0	2377	780	88	21	2106	2147

ANAM-USMC Male Normative Data (n = 107)							
Memory Search (Sternberg - 6)							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	0	1152	572	89	48	986
STD DEV	0	0	301	311	8	13	235
MIN	0	0	721	186	70	22	652
MAX	1	0	2371	1695	100	80	1942
MEDIAN	0	0	1071	483	90	48	918

ANAM-USMC Male Normative Data (n = 104)							
Matching to Sample							
Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All
MEAN	0	1554	644	92	39	1373	1385
STD DEV	0	475	413	8	13	354	367
MIN	0	662	175	67	13	629	618
MAX	1	2983	2284	100	84	2321	2404
MEDIAN	0	1532	521	83	36	1348	1345

Table 5
ANAM-USMC Normative Data
Male Data (n = 114)

ANAM-USMC Male Normative Data (n = 110) Code Substitution (Visual Scanning)						
Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	Thruput MDN Corr MDN All
MEAN	0	1235	460	96	1123	1123
STD DEV	0	278	179	3	248	246
MIN	0	759	155	86	616	618
MAX	0	2331	1213	100	2027	2027
MEDIAN	0	1208	449	97	1070	1067

ANAM-USMC Male Normative Data (n = 113) Code Substitution (Immediate Recall)						
Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	Thruput MDN Corr MDN All
MEAN	0	1300	535	92	1138	1146
STD DEV	0	338	369	9	220	224
MIN	0	823	138	50	783	809
MAX	2	2393	1841	100	1800	1917
MEDIAN	0	1257	421	94	1129	1122

ANAM-USMC Male Normative Data (n = 114) Code Substitution (Delayed Recall)						
Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD	MRT	% Acc	Thruput MDN Corr MDN All
MEAN	0	1273	611	89	1078	1088
STD DEV	0	393	620	11	233	255
MIN	0	743	105	50	689	689
MAX	2	3033	2330	100	1911	2255
MEDIAN	0	1203	431	94	1025	1038

Table 6
ANAM-USMC Retest Data
Session 2 (30-Day Retest)

USMC Retest Data (n = 49) Subject Statistics Session 2 - 1			
Mean	Age	Educ	12
SD	2	1	
Median	17	12	
Min.	26	16	
Max.	12	12	

USMC Retest Data (n = 49) STANFORD SLEEPSCALE Session 2 - 1			
Mean	Score	Time (ms)	
SD	2	5331	
Median	3	21913	
Min.	1	7055	
Max.	7	35398	

USMC Retest Data (n = 49) STANFORD SLEEPSCALE Session 2 - 2			
Mean	Score	Time (ms)	
SD	2	8597	
Median	5	7418	
Min.	1	1554	
Max.	7	49365	

USMC Normative Retest Data (n = 49) Simple Reaction Time (Session 2 - 1) Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD	MRT	% Acc	Thruput	MDN All
MEAN	0	284	123		100	227	259
STD DEV	0	102	273		0	49	75
MIN	0	194	21		100	84	191
MAX	0	711	1460		100	309	687
MEDIAN	0	254	61		100	236	242

USMC Normative Retest Data (n = 49) Simple Reaction Time (Session 2 - 2) Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD	MRT	% Acc	Thruput	MDN All
MEAN	0	316	142		100	209	275
STD DEV	0	127	163		0	55	76
MIN	0	163	24		100	63	159
MAX	0	945	758		100	369	652
MEDIAN	0	274	88		100	219	252

USMC Normative Retest Data (n = 49) Simple Reaction Time (Session 2 - 3) Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD	MRT	% Acc	Thruput	MDN All
MEAN	0	309	154		100	213	268
STD DEV	0	127	212		0	56	71
MIN	0	176	30		100	61	163
MAX	0	986	964		100	340	612
MEDIAN	0	281	77		100	214	255

USMC Retest Normative Data INVALID OUTLIERS REMOVED (n = 28) Continuous Performance Task - Running Memory (CPT80) Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD	MRT	% Acc	Thruput	MDN All
MEAN	2	585	181		90	93	563
STD DEV	2	79	39		7	15	82
MIN	0	374	115		66	70	385
MAX	7	693	244		100	123	683
MEDIAN	1	596	178		91	89	571

USMC Retest Normative Data INVALID OUTLIERS REMOVED (n = 25) Continuous Performance Task - Running Memory (CPT160) Summary Statistics for Specified Measures							
	Lapses	Mean RT	SD	MRT	% Acc	Thruput	MDN All
MEAN	3	571	216		89	94	537
STD DEV	3	106	76		10	17	100
MIN	0	350	107		61	60	301
MAX	10	791	343		100	120	749
MEDIAN	2	548	211		92	93	525

Table 6
ANAM-USMC Retest Data
Session 2 (30-Day Retest)

USMC Normative Retest Data (n = 49)							
Digit Set Comparison							
Summary Statistics for Specified Measures							
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All	
MEAN	1	1509	734	82	33	1322	1377
STD DEV	1	365	370	10	9	318	340
MIN	0	761	192	54	15	595	563
MAX	4	2309	2066	96	60	2306	2206
MEDIAN	0	1493	656	83	32	1293	1346

USMC Normative Retest Data (n = 36)							
Logical Relations (symbols)							
Summary Statistics for Specified Measures							
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All	
MEAN	0	1923	682	84	29	1812	1794
STD DEV	0	566	400	12	10	513	477
MIN	0	612	129	50	8	604	595
MAX	0	3356	1942	94	68	3042	2712
MEDIAN	0	1861	617	88	27	1762	1792

USMC Normative Retest Data (n = 44)							
Mathematical Processing							
Summary Statistics for Specified Measures							
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All	
MEAN	0	2762	1199	87	20	2515	N/A
STD DEV	0	824	609	15	7	736	N/A
MIN	0	1542	382	13	3	1316	N/A
MAX	1	4738	2978	100	39	4178	N/A
MEDIAN	0	2515	1071	90	20	2317	N/A

USMC Normative Retest Data (n = 49)							
Memory Search (Sternberg - 6)							
Summary Statistics for Specified Measures							
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All	
MEAN	0	1037	555	90	55	865	N/A
STD DEV	0	256	308	10	15	195	N/A
MIN	0	629	123	63	28	598	N/A
MAX	0	1636	1722	100	87	1538	N/A
MEDIAN	0	1017	474	93	55	811	N/A

USMC Normative Retest Data (n = 41)							
Spatial Processing (Simultaneous)							
Summary Statistics for Specified Measures							
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All	
MEAN	0	2279	875	85	24	2114	N/A
STD DEV	0	688	596	11	7	648	N/A
MIN	0	1170	270	60	10	1055	N/A
MAX	0	4277	2595	100	45	4775	N/A
MEDIAN	0	2129	660	87	23	1955	N/A

USMC Normative Retest Data (n = 49)							
Matching to Sample							
Summary Statistics for Specified Measures							
Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN Corr	MDN All	
MEAN	0	1535	685	85	35	1337	N/A
STD DEV	0	497	405	14	14	468	N/A
MIN	0	786	160	40	8	761	N/A
MAX	1	3678	1802	100	76	3773	N/A
MEDIAN	0	1529	591	87	32	1256	N/A

Table 6
ANAM-USMC Retest Data
Session 2 (30-Day Retest)

USMC Retest Data (n = 49)						
Code Substitution (Visual Scanning)						
Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN All
MEAN	0	1129	643	94	54	939
STD DEV	0	332	452	4	14	215
MIN	0	691	210	81	27	581
MAX	1	2040	2394	100	85	1571
MEDIAN	0	1049	457	95	54	890

USMC Retest Data (n = 49)						
Code Substitution (Immediate Recall)						
Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN All
MEAN	0	1132	475	89	49	1010
STD DEV	0	281	320	11	14	221
MIN	0	745	125	63	23	707
MAX	1	2085	1512	100	75	1634
MEDIAN	0	1070	379	91	49	937

USMC Retest Data (n = 46)						
Code Substitution (Delayed Recall)						
Summary Statistics for Specified Measures						
	Lapses	Mean RT	SD MRT	% Acc	Thruput	MDN All
MEAN	0	1174	589	86	48	989
STD DEV	0	401	525	11	15	252
MIN	0	700	147	50	17	593
MAX	1	2739	2219	100	82	1905
MEDIAN	0	1046	333	88	49	932

Table 7. USMC HEAT-STRESS RESULTS (Group Summary Data)
Means, (Standard Deviations), & Sample Size-N

	INITIAL BASELINE TEST			RETEST		
	Accuracy	Efficiency	N	Accuracy	Efficiency	N
CDS	94 (12)	39** (11)	13	95 (3)	49 (13)	9
CDI	86 (16)	32*** (11)	14	92 (8)	45 (12)	9
CDD	84* (12)	39* (15)	14	90 (6)	51 (7)	9
ST6	83** (9)	37*** (12)	14	94 (4)	49 (16)	8
CPT 80	88* (6)	82 (13)	10	94 (4)	49 (16)	8
CPT 160	93 (6)	95 (16)	8	93 (4)	100 (19)	8
DGS	91 (8)	31* (7)	13	96 (6)	37 (7)	9
LRS	88 (6)	19 (6)	11	91 (3)	26 (5)	9
MSP	88 (9)	26*** (8)	14	96 (6)	24 (5)	9
MTH	95 (5)	17* (5)	11	96 (6)	24 (5)	9
SPD	88 (7)	16*** (5)	12	93 (5)	23 (6)	9
SRT1	100	206 (41)	14	100	247 (24)	9
SRT2	100	187* (34)	12	100	247 (24)	9
SRT3	100	211 (24)	12	100	233 (36)	9
SLP	3→4	N/A	14	3→4	N/A	9
Significantly below normal levels: * $p < .05$, ** $p < .01$, *** $p < .0001$						

Table 8. USMC HEAT-STRESS RESULTS (Individual Data)
Subject ID: 2729

	INITIAL BASELINE		RETEST	
	Accuracy	Efficiency	Accuracy	Efficiency
CDS	97	25**	98	46
CDI	88	29*	100	54
CDD	88	33*	94	51
ST6	90	26**	97	36*
CPT-80	89	63*	96	96
CPT-160	92	66*	96	102
DGS	71**	17**	83	23*
LRS	81	8**	94	17*
MSP	93	19*	100	39
MTH	100	11**	93	16
SPD	100	14*	93	22
SRT1	100	151**	100	196
SRT2	100	159**	100	192
SRT3	100	176*	100	208
SLP	4*→4	N/A	2→2	N/A
* Between 5th & 15th Percentile **5th Percentile or Below				

Neuropsychological Evaluation Summary Note: Subject S2729 is an 18 year old Caucasian female, E1\AD\USMC (PVT\URT) with 12 years of education. Results from an initial administration of the USMC-ANAM (18 AUG 95) which followed a "heat-stress" episode suggest that this individual was moderately impaired regarding the ability to sustain high levels of attention and concentration (e.g., Digit Set Comparison Accuracy=71%). While she retained the mental power to perform most tasks within normal limits for accuracy measures of neurocognitive function, her efficiency scores were moderately and globally impaired. These results support the clinical observation of symptoms of heat exhaustion, which included mental dullness and a significant reduction of speed of information processing.

Results from follow-up evaluations conducted on 20 AUG 95 and 16 SEP 95 revealed significant improvement in her mental power and attention abilities (e.g., Digit Set Comparison Accuracy=88% & 83% respectively). There was also notable improvement regarding mental processing efficiency on the majority of tests. However, her performance remained in the mildly impaired range on three tests, suggesting that full recovery had not as yet taken place (e.g., Efficiency scores = 36, 23, & 17 for Sternberg-6 Memory Search, Digit Set Comparison, & Matching to Sample respectively).

and determining whether they were between -1.64 and -1.00, placing them within the 5th-15th percentiles. Any raw score corresponding to a Z-score of -1.64 or negatively greater was equivalent to the 5th percentile or below (statistically significantly below normal). This procedure is similar to that described by Kay (1995).

Continuous recording of body core temperature.

Although we administered over 1300 CorTemp sensors to our volunteers, we have only approximately 380 usable temperature records from male recruits, and 350 from female recruits. (About 25 of these records include data obtained during road marches with loads, and the rest include data obtained during distance runs.) For male recruits the distance runs are mostly of 3 miles, while for female recruits they are of several different distances, most less than 3 miles. Inspection of plots of T_{core} against time shows that in the hot season, the recruits never reach thermal steady state during distance runs, and T_{core} continues to rise until the end of the run. These data have not yet been analyzed statistically, but we will attempt to generate equations that will predict an individual's T_{core} during a run as a function of time, WBGT, the individual's BMI and PFT run time, week of basic training, sex and, for female recruits, phase of the menstrual cycle.

Problems. As noted in the previous paragraph, a high proportion of records of core temperature were not usable. Problems with the records were of two sorts. In many cases, especially near the beginning of the study, the ingestible CorTemp sensors appeared to be defective. Evidence that we

interpreted as indicating defective sensors consisted of temperatures or changes in temperature during the course of a record that were physiologically unrealistic. Each sensor comes with a calibration supplied by the manufacturer, and the sensors are advertised to be accurate to 0.1°C. Because of suspicions about the accuracy and stability of the calibration, we began checking the calibration of each sensor using a temperature-controlled water bath and certified mercury-in-glass thermometer, and returned to the manufacturer sensors whose accuracy did not meet the specifications. After we began this practice, the frequency of apparently defective sensors was reduced dramatically. (This project purchases a substantial portion of manufacturer's total output of CorTemp sensors, and we suspect that the manufacturer had difficulty maintaining quality control during production of large lots.) The other problems that we have identified relate to movement of the antennas and/or the recorders, resulting either in loss of the signal or electrical "feedback" between antenna and recorder. These problems usually did not interfere with obtaining temperature signals when subjects are at rest or walking, but frequently caused loss of the signal during running. We began the study using the inexpensive loop antennas, which wrap about the subject's torso. During running, however, the antennas sometimes worked their way up the subject's chest and "lost" the signal from the sensor. To prevent movement of the loop antennas, we sewed each one into a mesh vest. However we still often lost the temperature signal during running, and noticed that signal loss occurred more frequently with female subjects. After consulting with the manufacturer we began to suspect that this problem was due to

"feedback" between the antenna and recorder, which occurs if the antenna and recorder come too close to each other. Bouncing of the recorder and antenna during running could bring them too close together; and since women are several inches shorter than men, the distance between antenna and recorder would be less even without any movement. We therefore tried replacing the loop antennas with more expensive antennas which each have two ferrite elements strapped to the chest. If the recorder is worn at the belt, as it is in our experiments, this antenna is easier to keep at a safe distance from the recorder. Most of our temperature recordings during the 1996 hot season were made with ferrite antennas, and a preliminary count indicates that close to 75% of the temperature records are usable, compared to fewer than 40% of the records during the 1995 hot season.

CONCLUSIONS

Assessment of Cognitive Function.

ANAM 3.11a has been used previously in other enlisted populations, but not in recruit populations. Because of the nature and degree of stress to which Marine recruits are subjected, it was first necessary to test healthy members of this population group in order to establish valid norms with which to compare performance of EHI patients, and to demonstrate that our test battery is capable of distinguishing patients from normal recruits.

The pattern of cognitive performance by our hyponatremia patients during their initial test is similar to that exhibited by traumatic brain injury (TBI) patients (Levinson and Reeves, in

press). In contrast to performance of the TBI patients, however, performance of the hyponatremia patients, as a group, had returned to within normal limits by the time of their retest. Our experience thus far with the USMC subset of ANAM 3.11a shows its utility for assessing acute cognitive impairments in this population. With the normative data that we have obtained for this Marine recruit population, we are well positioned for a more extensive study of the effects of exercise-heat stress and EHI on cognitive performance.

Collection of blood samples.

The requirements for collecting and handling blood samples for our intended immunological assays are rather demanding, and the quality of the samples collected this past summer will provide a test of how well we have the necessary procedures in hand. If, as we expect, these samples prove to be of good quality, they will show that we have the necessary procedures well in hand. If not, we will need to review our procedures, make whatever changes are indicated, and collect and analyze another test batch of samples before carrying out the much larger-scale collections planned for next year. The results of the analyses on EHI patients will give some indication of the analyses that are most likely to provide useful information about the pathogenesis and course of EHI, and about the time-course of changes in these responses and thus about the sampling schedule that is most likely to be useful. In addition analysis of the 65 control samples should provide some useful data about baseline responses and their distribution, and aid in planning further collection of samples from controls.

Continuous recording of body core temperature.

The equations that we expect to generate predicting an individual's T_{core} during a run as a function of time, WBGT, the individual's BMI and PFT run time, week of basic training, sex and, for female recruits, phase of the menstrual cycle, will furnish norms against which to compare presenting rectal temperatures of EHI patients. We will thus have a basis for drawing conclusions regarding the extent to which development of EHI is associated with patients' reaching a higher level of T_{core} than levels reached by healthy recruits performing the same activities under the same conditions, and the extent to which it is associated with patients' being less tolerant to high T_{core} . Furthermore, we will have a basis for inferences about whether individual risk factors (e.g., high BMI) for developing EHI act because of an association with high levels of T_{core} during exercise or in some other way.

Collection and organization of clinical data on EHI patients.

The new database is congruent with the data forms, and minimizes the number of ad hoc judgments associated with entry of case data compared to what was involved with the previous database that was inherited from the project "Heat injury among Marine recruits". In addition, its structure simplifies extraction of the data fields necessary for many specific analyses. Collection of the 1995 and 1996 clinical EHI data increases not only the total number of cases in the databases for epidemiological analyses but, more significantly increases the much smaller numbers of cases for which we have been able to

verify the training event at onset of the episode of EHI from published recruit training schedules, which are available beginning only in 1993; and of female cases for which we have data about the phase of the patient's menstrual cycle, which were recorded only beginning in 1993.

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APPENDIX A

ABBREVIATIONS

ALT(SGPT) - alanine aminotransferase
ANAM - Automated Neuropsychological Assessment Metrics Battery
Anti-LPS - antibody against LPS
AST(SGOT) - aspartate aminotransferase
BMI - body mass index (weight/height^2)
CPK - creatine phosphokinase
EDTA - ethylene diamine tetra-acetic acid, used as an
anticoagulant
EHI - exertional heat injury
ELISA - Enzyme-linked immunosorbent assay
IgG - immunoglobulin G
IL-1, IL-1 α , IL-1 β , IL-6 - interleukin 1, interleukin 1 α ,
interleukin 1 β , interleukin 6
LDH - lactic dehydrogenase
LPS - lipopolysaccharide endotoxin
MCRD - Marine Corps Recruit Depot
PFT - Physical fitness test
T_{core} - body core temperature
TNF - tumor necrosis factor
USARIEM - US Army Research Institute of Environmental Medicine
Vo_{2max} - maximal rate of O₂ uptake

APPENDIX B. Background Questionnaires

- Appendix B1 Background questionnaire for male EHI patients (enrollment section only) and male control volunteers who give blood samples.
- Appendix B2 Background questionnaire for female EHI patients (enrollment section only) and female control volunteers who give blood samples.
- Appendix B3 Background questionnaire for male volunteers who swallow the telemetric temperature sensors.
- Appendix B4 Background questionnaire for female volunteers who swallow the telemetric temperature sensors.

Note: Each of these questionnaires consists of two parts. The first (and longer) part is a background questionnaire administered to a volunteer upon enrollment in the corresponding phase of the study. The second part consists of a few questions about the recent activity and health of the volunteer, and is administered whenever that volunteer's core temperature is measured, or he/she gives a blood sample or undergoes psychological testing. All parts of a particular questionnaire administered to a given volunteer will be kept as a single package.

APPENDIX B1

QUESTIONNAIRE FOR MALE LAB COHORT (8/15/96)

Privacy Act Statement

Authority: 5 U.S.C. 301; 10 U.S.C. 1071-1090; 44 U.S.C. 3101; E.O. 9397; DA PAM 25-51, Paragraph 14-4

Purpose and routine use: To help researchers analyze demographic and physiological data in connection with heat injuries among Marine recruits. Your name/social security number is needed during the study to assure accuracy in matching your answers on this form to physiological measurements made on you. When data analysis is completed, your name/social security number will be removed from the questionnaires. The rest of the information that you provide on this form will remain part of the research file until it is eligible for destruction. Investigators responsible for the conduct of this study are at the US Army Research Institute of Environmental Medicine, Natick, Massachusetts, 01760, and the Naval Hospital, Beaufort, South Carolina, 29902. Only these investigators and those working under their supervision will have access to the information that you provide. Information collected in this study will be treated as confidential to the extent permitted by applicable law. Reports regarding this study will not include individual names or other personal identifiers.

Disclosure: Personal information on this form is given on a voluntary basis. Failure to give an answer to any question on this questionnaire will not affect your right to participate in the remainder of this study.

READ ALL QUESTIONS CAREFULLY; ANSWER ALL QUESTIONS TO THE BEST OF YOUR RECOLLECTION BY CIRCLING THE APPROPRIATE ANSWER AND/OR FILLING IN THE BLANK.

Today's date ____/____/____
Month Day Year

Last Name: _____

First Name: _____ Middle initial _____

Social Security Number: ____ - ____ - ____

Platoon number: ____

1. In the six months before reporting to PARRIS ISLAND, on average, how many cigarettes did you smoke per day?

0 - None, I did not smoke.

_____ cigarettes smoked per day. (There are 20 in a pack.)

2. How many years have you regularly smoked cigarettes?

0 - I have not regularly smoked cigarettes.

_____ years

3. How many years have you regularly consumed one or more alcoholic drinks per week?

0 - None, I do not regularly drink alcohol.

_____ years

4. What is the maximum number of alcoholic drinks you have consumed per week on a regular basis? (One shot of whiskey, one glass of wine, and one 12-ounce beer each counts as one drink.)

0 - None, I do not regularly drink alcohol.

_____ alcoholic drinks consumed per week on a regular basis

5. In the 2 MONTHS BEFORE coming to PARRIS ISLAND how many times per week, on average, did you run or jog? (Circle one)

0 - Never (If you did not run/jog even once, skip to question 9.)

1 - 1 time or less per week

2 - 2 times per week

3 - 3 times per week

4 - 4 times per week

5 - 5 times per week

6 - 6 times per week

7 - 7 or more times per week

6. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, how much time did it usually take you to complete a single running or jogging workout?

— — — minutes

7. In the 2 MONTHS BEFORE coming to PARRIS ISLAND how hard, on average, did you exercise running or jogging?

1 - Very leisurely, breathing easy, as during a slow walk

2 - Leisurely, breathing and effort slightly greater than slow walk

3 - Average, breathing increased but not uncomfortable

4 - Intense, breathing hard, have to "push" to keep going

5 - Very intense, breathing labored, difficult to keep going

8. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, what was the most number of miles you ran at any one time?

_____ miles

9. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, how often did you exercise or play sports other than running or jogging?

0 - Never (If you did not do sports even once, skip to question 13.)

1 - 1 time or less per week

2 - 2 times per week

3 - 3 times per week

4 - 4 times per week

5 - 5 times per week

6 - 6 times per week

7 - 7 or more times per week

10. On days that you exercised or participated in sports other than running/jogging, how many minutes, on average, did you exercise or participate in sports?

_____ minutes (average) of exercise/sports other than running/jogging each time I exercised.

11. In the 2 MONTHS BEFORE coming to PARRIS ISLAND how hard, on average, did you exercise or participate in sports other than running/jogging?

- 1 - Very leisurely, breathing easy, as during a slow walk
- 2 - Leisurely, breathing and effort slightly greater than slow walk
- 3 - Average, breathing increased but not uncomfortable
- 4 - Intense, breathing hard, have to "push" to keep going
- 5 - Very intense, breathing labored, difficult to keep going

12. What were the three sports you participated in most often, other than running/jogging? Please write in "1" for the most frequent, "2" for the second most frequent, and "3" for the third most frequent. Do not number more than three. Read all before answering.

- _____ Aerobics
- _____ Walking
- _____ Basketball
- _____ Football
- _____ Soccer
- _____ Rugby
- _____ Baseball
- _____ Softball
- _____ Bicycling
- _____ Swimming
- _____ Tennis
- _____ Rowing
- _____ Shot put and/or discus throwing
- _____ Roller Blading
- _____ Hockey
- _____ Weight lifting
- _____ Other sports _____

13. Compared to others your same age and sex, how would you describe your overall physical activity before reporting to PARRIS ISLAND?

- A. Inactive
- B. Not very active
- C. Average
- D. Very active

14. How would you rate your physical fitness prior to coming to PARRIS ISLAND compared to others your same age and sex? (Circle one answer.)

- | | | | | |
|------|------|------|-----------|-----------|
| 1 | 2 | 3 | 4 | 5 |
| Poor | Fair | Good | Very good | Excellent |

15. Do you take any medications on a regular basis, including birth control pills? (Circle one answer.)

0 - No

1 - Yes, please list: _____

16. Have you ever been sick from the heat, for example, heat exhaustion, heat stroke?

0 - No

1 - Yes: If yes, please specify what year, 19____.

What was the diagnosis? (Circle one.)

1 - heat exhaustion

2 - heat stroke

3 - other _____

17. Have you ever been in MRP? 0 - No 1 - Yes

18. Have you ever been in PCP? 0 - No 1 - Yes

19. During your lifetime, have you ever been unconscious (blacked-out for more than 5 minutes)? 0 - No 1 - Yes
(If no, skip to question 22.)

20. What was the cause of unconsciousness? _____

21. How long were you unconscious?

- A. 5 to 14 minutes
- B. 15 to 29 minutes
- C. 30 to 59 minutes
- D. 1 hour to 3 hours 59 minutes
- E. 4 hours to 10 hours
- F. More than 10 hours

22. Have you ever experienced any of the following?

Head Injury with skull fracture	0 - No	1 - Yes
Head Injury without skull fracture	0 - No	1 - Yes
Drug overdose	0 - No	1 - Yes
Seizures	0 - No	1 - Yes
Fainting	0 - No	1 - Yes

23. Have you ever had any of the following brain infections?

Meningitis (spinal) (infection of brain coverings)	0 - No	1 - Yes
Encephalitis (infection in brain)	0 - No	1 - Yes

24. Have you ever been treated for any of the following:

Major Depression	0 - No	1 - Yes
Schizophrenia	0 - No	1 - Yes
Brain tumor	0 - No	1 - Yes
Epilepsy (recurring seizure illness)	0 - No	1 - Yes

25. Have you had any other brain disorder (illness or injury) which was not covered by the previous questions?

0 - No, I have not had any other brain disorder

1 - Yes, I had the following disorder:

26. Have you ever been in treatment for drug or alcohol abuse?	0 - No	1 - Yes
--	--------	---------

27. Have you ever been a patient at a psychiatric hospital?	0 - No	1 - Yes
---	--------	---------

28. Did you have speech or language difficulties as a child?	0 - No	1 - Yes
--	--------	---------

29. Did you need special classes or tutoring while in school? 0 - No 1 - Yes
30. Did you have behavior problems as a child? 0 - No 1 - Yes
31. Have you ever been told you have a learning disability? 0 - No 1 - Yes
32. Have you ever had a urinary tract infection (UTI) (infection of bladder or kidneys)? For women this does not include vaginal infections like yeast, trichomonas, etc. 0 - No 1 - Yes
33. Have you ever had a wound infection (infection in a cut or surgical wound)? 0 - No 1 - Yes
34. Has your appendix been removed? (If no, skip to question 37.) 0 - No 1 - Yes
35. Why was your appendix removed?
- A. They thought I had appendicitis, but after it was removed they found my appendix was normal (Skip to question 37.)
 - B. My appendix was removed because I had surgery for another reason and they simply decided to take my appendix out because the surgeon had opened my stomach (Skip to question 37.)
 - C. I definitely had appendicitis
 - D. I think I had appendicitis
 - E. I don't know why my appendix was removed
36. Did you have a ruptured appendix?
- A. No, I had appendicitis but my appendix was definitely not ruptured.
 - B. Unlikely, I had appendicitis and I think my appendix was not ruptured.
 - C. Possibly, I had appendicitis and I think my appendix was ruptured.
 - D. Yes, I had appendicitis and my appendix was definitely ruptured.
37. Have you ever cared for farm animals like horses, cows, chickens, pigs, etc.? (If no, skip to question 39.) 0 - No 1 - Yes
38. How long did you care for farm animals?
 _____ Number of years I cared for farm animals.

M39. In the month prior to reporting to PARRIS ISLAND, did you work at a job that required hard labor?

0 - No (If No, STOP)

1 - Yes (If Yes, GO ON TO QUESTIONS 41-43.)

M40. For your hard labor job in the two months before reporting to PARRIS ISLAND, how many hours per week was the work "very intense" hard labor? Very intense hard labor is where your breathing is hard and you have to "push" to keep going.

_____ hours per week of very intense hard labor.

M41. For your hard labor job in the two months before reporting to PARRIS ISLAND, how many hours per week was the work "intense" hard labor? Intense hard labor is where your breathing is increased but not uncomfortable

_____ hours per week of intense hard labor.

M42. What hard labor job did you work at?

1. Farming

2. Furniture moving

3. Construction

4. Other _____

END OF ENROLLMENT QUESTIONNAIRE

TEST ONE QUESTIONNAIRE

1. Did you have any watch last night? (Circle all that apply.)
0 - No, I did not have watch last night. If no, skip to question #3
1 - Yes, I had fire watch last night.
2 - Yes, I had guard mount watch last night.
2. What time did you have watch last night?
_____ to _____
Hour Hour
3. How many hours of sleep did you have last night?
_____ hours of sleep
4. How many canteens of water did you drink yesterday up until the time you went to bed?
_____ canteens of water
5. How many canteens of water did you drink last night after lights out and before wake-up call this morning?
_____ canteens of water
6. How many canteens of water did you drink since wake-up this morning?
_____ canteens of water
7. In the last 24 hours, did you drink any water not from a canteen?
0 - No
1 - Yes If yes, estimate the number of glasses _____
8. How many glasses of juice, punch, or other drink (not water or milk) did you drink yesterday?
_____ number of glasses
9. How many glasses of juice, punch, or other drink (not water or milk) did you have with breakfast this morning?
_____ number of glasses
10. Did you go to sick call in the last two weeks? (Circle one answer.)
0 - No
1 - Yes. If yes, write the diagnosis. _____

11. Have you felt well in the last three days? (Circle one answer.)

0 - No If no, describe your symptoms and/or illness: _____

1 - Yes

12. In the past 3 days have you had a ...?

Cold:	0 - No	1 - Yes
Sore throat:	0 - No	1 - Yes
Fever/Chills:	0 - No	1 - Yes
Fainting:	0 - No	1 - Yes
Nausea	0 - No	1 - Yes
Vomiting	0 - No	1 - Yes
Diarrhea	0 - No	1 - Yes
Constipation	0 - No	1 - Yes
Painful urination	0 - No	1 - Yes
Blood in urine	0 - No	1 - Yes
Strain/Sprain	0 - No	1 - Yes
broken bone)	0 - No	1 - Yes
Fast or irregular heart beat	0 - No	1 - Yes
Cellulitis (skin infection)	0 - No	1 - Yes
Sunburn, over more than one third of body	0 - No	1 - Yes
Cut in skin longer than 2" and deeper than 1/8	0 - No	1 - Yes

END OF TEST ONE QUESTIONNAIRE

APPENDIX B2

QUESTIONNAIRE FOR FEMALE LAB COHORT (8/15/96)

Privacy Act Statement

Authority: 5 U.S.C. 301; 10 U.S.C. 1071-1090; 44 U.S.C. 3101; E.O. 9397; DA PAM 25-51, Paragraph 14-4

Purpose and routine use: To help researchers analyze demographic and physiological data in connection with heat injuries among Marine recruits. Your name/social security number is needed during the study to assure accuracy in matching your answers on this form to physiological measurements made on you. When data analysis is completed, your name/social security number will be removed from the questionnaires. The rest of the information that you provide on this form will remain part of the research file until it is eligible for destruction. Investigators responsible for the conduct of this study are at the US Army Research Institute of Environmental Medicine, Natick, Massachusetts, 01760, and the Naval Hospital, Beaufort, South Carolina, 29902. Only these investigators and those working under their supervision will have access to the information that you provide. Information collected in this study will be treated as confidential to the extent permitted by applicable law. Reports regarding this study will not include individual names or other personal identifiers.

Disclosure: Personal information on this form is given on a voluntary basis. Failure to give an answer to any question on this questionnaire will not affect your right to participate in the remainder of this study.

READ ALL QUESTIONS CAREFULLY; ANSWER ALL QUESTIONS TO THE BEST OF YOUR RECOLLECTION BY CIRCLING THE APPROPRIATE ANSWER AND/OR FILLING IN THE BLANK.

Today's date ____/____/____
Month Day Year

Last Name: _____

First Name: _____ Middle initial _____

Social Security Number: ____ - ____ - ____

Platoon number: ____

1. In the six months before reporting to PARRIS ISLAND, on average, how many cigarettes did you smoke per day?

0 - None, I did not smoke.

_____ cigarettes smoked per day. (There are 20 in a pack.)

2. How many years have you regularly smoked cigarettes?

0 - I have not regularly smoked cigarettes.

_____ years

3. How many years have you regularly consumed one or more alcoholic drinks per week?

0 - None, I do not regularly drink alcohol.

_____ years

4. What is the maximum number of alcoholic drinks you have consumed per week on a regular basis? (One shot of whiskey, one glass of wine, and one 12-ounce beer each counts as one drink.)

0 - None, I do not regularly drink alcohol.

_____ alcoholic drinks consumed per week on a regular basis

5. In the 2 MONTHS BEFORE coming to PARRIS ISLAND how many times per week, on average, did you run or jog? (Circle one)

0 - Never (If you did not run/jog even once, skip to question 9.)

1 - 1 time or less per week

2 - 2 times per week

3 - 3 times per week

4 - 4 times per week

5 - 5 times per week

6 - 6 times per week

7 - 7 or more times per week

6. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, how much time did it usually take you to complete a single running or jogging workout?

— — — minutes

7. In the 2 MONTHS BEFORE coming to PARRIS ISLAND how hard, on average, did you exercise running or jogging?

1 - Very leisurely, breathing easy, as during a slow walk

2 - Leisurely, breathing and effort slightly greater than slow walk

3 - Average, breathing increased but not uncomfortable

4 - Intense, breathing hard, have to "push" to keep going

5 - Very intense, breathing labored, difficult to keep going

8. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, what was the most number of miles you ran at any one time?

_____ miles

9. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, how often did you exercise or play sports other than running or jogging?

0 - Never (If you did not do sports even once, skip to question 13.)

1 - 1 time or less per week

2 - 2 times per week

3 - 3 times per week

4 - 4 times per week

5 - 5 times per week

6 - 6 times per week

7 - 7 or more times per week

10. On days that you exercised or participated in sports other than running/jogging, how many minutes, on average, did you exercise or participate in sports?

_____ minutes (average) of exercise/sports other than running/jogging each time I exercised.

11. In the 2 MONTHS BEFORE coming to PARRIS ISLAND how hard, on average, did you exercise or participate in sports other than running/jogging?

- 1 - Very leisurely, breathing easy, as during a slow walk
- 2 - Leisurely, breathing and effort slightly greater than slow walk
- 3 - Average, breathing increased but not uncomfortable
- 4 - Intense, breathing hard, have to "push" to keep going
- 5 - Very intense, breathing labored, difficult to keep going

12. What were the three sports you participated in most often, other than running/jogging? Please write in "1" for the most frequent, "2" for the second most frequent, and "3" for the third most frequent. Do not number more than three. Read all before answering.

- _____ Aerobics
- _____ Walking
- _____ Basketball
- _____ Football
- _____ Soccer
- _____ Rugby
- _____ Baseball
- _____ Softball
- _____ Bicycling
- _____ Swimming
- _____ Tennis
- _____ Rowing
- _____ Shot put and/or discus throwing
- _____ Roller Blading
- _____ Hockey
- _____ Weight lifting
- _____ Other sports _____

13. Compared to others your same age and sex, how would you describe your overall physical activity before reporting to PARRIS ISLAND?

- A. Inactive
- B. Not very active
- C. Average
- D. Very active

14. How would you rate your physical fitness prior to coming to PARRIS ISLAND compared to others your same age and sex? (Circle one answer.)

- | | | | | |
|------|------|------|-----------|-----------|
| 1 | 2 | 3 | 4 | 5 |
| Poor | Fair | Good | Very good | Excellent |

15. Do you take any medications on a regular basis, including birth control pills? (Circle one answer.)

0 - No

1 - Yes, please list: _____

16. Have you ever been sick from the heat, for example, heat exhaustion, heat stroke?

0 - No

1 - Yes: If yes, please specify what year, 19____.

What was the diagnosis? (Circle one.)

1 - heat exhaustion

2 - heat stroke

3 - other _____

17. Have you ever been in MRP? 0 - No 1 - Yes

18. Have you ever been in PCP? 0 - No 1 - Yes

19. During your lifetime, have you 0 - No 1 - Yes
ever been unconscious (blacked-
out for more than 5 minutes)?
(If no, skip to question 22.)

20. What was the cause of unconsciousness? _____

21. How long were you unconscious?

- A. 5 to 14 minutes
- B. 15 to 29 minutes
- C. 30 to 59 minutes
- D. 1 hour to 3 hours 59 minutes
- E. 4 hours to 10 hours
- F. More than 10 hours

22. Have you ever experienced any of the following?

Head Injury with skull fracture	0 - No	1 - Yes
Head Injury without skull fracture	0 - No	1 - Yes
Drug overdose	0 - No	1 - Yes
Seizures	0 - No	1 - Yes
Fainting	0 - No	1 - Yes

23. Have you ever had any of the following brain infections?

Meningitis (spinal) (infection of brain coverings)	0 - No	1 - Yes
Encephalitis (infection in brain)	0 - No	1 - Yes

24. Have you ever been treated for any of the following:

Major Depression	0 - No	1 - Yes
Schizophrenia	0 - No	1 - Yes
Brain tumor	0 - No	1 - Yes
Epilepsy (recurring seizure illness)	0 - No	1 - Yes

25. Have you had any other brain disorder (illness or injury) which was not covered by the previous questions?

0 - No, I have not had any other brain disorder

1 - Yes, I had the following disorder:

26. Have you ever been in treatment for drug or alcohol abuse?	0 - No	1 - Yes
---	--------	---------

27. Have you ever been a patient at a psychiatric hospital?	0 - No	1 - Yes
--	--------	---------

28. Did you have speech or language difficulties as a child?	0 - No	1 - Yes
---	--------	---------

29. Did you need special classes or tutoring while in school? 0 - No 1 - Yes
30. Did you have behavior problems as a child? 0 - No 1 - Yes
31. Have you ever been told you have a learning disability? 0 - No 1 - Yes
32. Have you ever had a urinary tract infection (UTI) (infection of bladder or kidneys)? For women this does not include vaginal infections like yeast, trichomonas, etc. 0 - No 1 - Yes
33. Have you ever had a wound infection (infection in a cut or surgical wound)? 0 - No 1 - Yes
34. Has your appendix been removed? (If no, skip to question 37.) 0 - No 1 - Yes
35. Why was your appendix removed?
- A. They thought I had appendicitis, but after it was removed they found my appendix was normal (Skip to question 37.)
 - B. My appendix was removed because I had surgery for another reason and they simply decided to take my appendix out because the surgeon had opened my stomach (Skip to question 37.)
 - C. I definitely had appendicitis
 - D. I think I had appendicitis
 - E. I don't know why my appendix was removed
36. Did you have a ruptured appendix?
- A. No, I had appendicitis but my appendix was definitely not ruptured.
 - B. Unlikely, I had appendicitis and I think my appendix was not ruptured.
 - C. Possibly, I had appendicitis and I think my appendix was ruptured.
 - D. Yes, I had appendicitis and my appendix was definitely ruptured.
37. Have you ever cared for farm animals like horses, cows, chickens, pigs, etc.? (If no, skip to question 39.) 0 - No 1 - Yes
38. How long did you care for farm animals?
 _____ Number of years I cared for farm animals.

F39. Have you ever had an infection of your uterus or uterine tubes (sometimes called PID or pelvic inflammatory disease)? This does not include vaginal infections like yeast, trichomonas, etc.

0 - No 1 - Yes

F40. How old were you when your first period began?

_____ Years

F41. In the past year, have your menstrual periods been at irregular times?

0 - No 1 - Yes

F42. In the past year, have you gone more than six months between any menstrual periods?

0 - No 1 - Yes

END OF ENROLLMENT QUESTIONNAIRE

TEST ONE QUESTIONNAIRE

1. Did you have any watch last night? (Circle all that apply.)
0 - No, I did not have watch last night. If no, skip to question #3
1 - Yes, I had fire watch last night.
2 - Yes, I had guard mount watch last night.
2. What time did you have watch last night?
_____ to _____
Hour Hour
3. How many hours of sleep did you have last night?
_____ hours of sleep
4. How many canteens of water did you drink yesterday up until the time you went to bed?
_____ canteens of water
5. How many canteens of water did you drink last night after lights out and before wake-up call this morning?
_____ canteens of water
6. How many canteens of water did you drink since wake-up this morning?
_____ canteens of water
7. In the last 24 hours, did you drink any water not from a canteen?
0 - No
1 - Yes If yes, estimate the number of glasses _____
8. How many glasses of juice, punch, or other drink (not water or milk) did you drink yesterday?
_____ number of glasses
9. How many glasses of juice, punch, or other drink (not water or milk) did you have with breakfast this morning?
_____ number of glasses
10. Did you go to sick call in the last two weeks? (Circle one answer.)
0 - No
1 - Yes. If yes, write the diagnosis. _____

11. Have you felt well in the last three days? (Circle one answer.)

0 - No If no, describe your symptoms and/or illness: _____

1 - Yes

12. In the past 3 days have you had a ...?

Cold:	0 - No	1 - Yes
Sore throat:	0 - No	1 - Yes
Fever/Chills:	0 - No	1 - Yes
Fainting:	0 - No	1 - Yes
Nausea	0 - No	1 - Yes
Vomiting	0 - No	1 - Yes
Diarrhea	0 - No	1 - Yes
Constipation	0 - No	1 - Yes
Painful urination	0 - No	1 - Yes
Blood in urine	0 - No	1 - Yes
Strain/Sprain	0 - No	1 - Yes
broken bone)	0 - No	1 - Yes
Fast or irregular heart beat	0 - No	1 - Yes
Cellulitis (skin infection)	0 - No	1 - Yes
Sunburn, over more than one third of body	0 - No	1 - Yes
Cut in skin longer than 2" and deeper than 1/8	0 - No	1 - Yes

F13 On the calendar below, circle the date of the start of bleeding for your last menstrual period.

TODAY'S DATE IS _____ [provided by research team]

If your last menstrual period started before January 1, 1996, check the box above the month of January.

☐ Started before January 1, 1996

1996

JANUARY							FEBRUARY							MARCH							APRIL						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
	1	2	3	4	5	6				1	2	3						1	2		1	2	3	4	5	6	
7	8	9	10	11	12	13	4	5	6	7	8	9	10	3	4	5	6	7	8	9	7	8	9	10	11	12	13
14	15	16	17	18	19	20	11	12	13	14	15	16	17	10	11	12	13	14	15	16	14	15	16	17	18	19	20
21	22	23	24	25	26	27	18	19	20	21	22	23	24	17	18	19	20	21	22	23	21	22	23	24	25	26	27
28	29	30	31	25	26	27	28	29	24	25	26	27	28	29	30	28	29	30									
														31													

MAY							JUNE							JULY							AUGUST						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3	4						1		1	2	3	4	5	6					1	2	3
5	6	7	8	9	10	11	2	3	4	5	6	7	8	7	8	9	10	11	12	13	4	5	6	7	8	9	10
12	13	14	15	16	17	18	9	10	11	12	13	14	15	14	15	16	17	18	19	20	11	12	13	14	15	16	17
19	20	21	22	23	24	25	16	17	18	19	20	21	22	21	22	23	24	25	26	27	18	19	20	21	22	23	24
26	27	28	29	30	31	23	24	25	26	27	28	29	28	29	30	31	25	26	27	28	29	30	31				
							30																				

SEPTEMBER							OCTOBER							NOVEMBER							DECEMBER							
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	
1	2	3	4	5	6	7				1	2	3	4	5						1	2	1	2	3	4	5	6	7
8	9	10	11	12	13	14	6	7	8	9	10	11	12	3	4	5	6	7	8	9	8	9	10	11	12	13	14	
15	16	17	18	19	20	21	13	14	15	16	17	18	19	10	11	12	13	14	15	16	15	16	17	18	19	20	21	
22	23	24	25	26	27	28	20	21	22	23	24	25	26	17	18	19	20	21	22	23	22	23	24	25	26	27	28	
29	30	27	28	29	30	31	24	25	26	27	28	29	30	29	30	31												

END OF TEST ONE QUESTIONNAIRE

HEIGHT

(cm) WT

APPENDIX B3

(kg) 96M (8/05/96)

Privacy Act Statement

Authority: 5 U.S.C. 301; 10 U.S.C. 1071-1090; 44 C.S.C. 3101; E.O. 9397; DA PAM 25-51, Paragraph 14-4

Purpose and routine use: To help researchers analyze demographic and physiological data in connection with heat injuries in Marine recruits. Your name/ social security number is needed during the study to assure accuracy in matching your answers on this form to physiological measurements made on you. When data analysis is completed, your name/social security number will be removed from the questionnaires and the rest of the information that you provide on this form will remain part of the research file until it is eligible for destruction. Investigators responsible for the conduct of this study are at the U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts, 01760, and the Naval Hospital, Beaufort, South Carolina, 29902. Only these investigators and those working under their supervision will have access to the information that you provide. Information collected in this study will be treated as confidential to the extent permitted by applicable law. Reports regarding this study will not include individual names or other personal identifiers.

Disclosure: Personal information on this form is given on a voluntary basis. Failure to give an answer to any question on this questionnaire will not affect your right to participate in the remainder of this study.

READ ALL QUESTIONS CAREFULLY; ANSWER ALL QUESTIONS TO THE BEST OF YOUR RECOLLECTION BY CIRCLING THE APPROPRIATE ANSWER AND/OR FILLING IN THE BLANK

Last name: _____

First name: _____ Middle initial: _____

Social Security Number _____ - _____ - _____

Platoon number: _____

1. In the six months before reporting to PARRIS ISLAND, on average, how many cigarettes did you smoke per day?

0 - None, I did not smoke.

_____ cigarettes smoked per day. (There are 20 in a pack.)

2. How many years have you regularly smoked cigarettes?

0 - I have not regularly smoked cigarettes.

_____ years.

3. How many years have you regularly consumed one or more alcoholic drinks per week?

0 - None, I do not regularly drink alcohol.

_____ years

4. What is the maximum number of alcoholic drinks you have consumed per week on a regular basis? (one shot of whiskey, one glass of wine, and one 12 ounce beer each counts as one drink)

0 - None, I do not regularly drink alcohol.

_____ alcoholic drinks consumed per week on a regular basis

5. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, on average, how many times per week did you run or jog? (circle one)

0 - Never (If you did not run/jog even once, skip to question 9)

1 - 1 time or less per week

2 - 2 times per week

3 - 3 times per week

4 - 4 times per week

5 - 5 times per week

6 - 6 times per week

7 - 7 or more times per week

6. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, how much time did it usually take you to complete a single running or jogging workout?

— — — minutes

7. In the 2 MONTHS BEFORE coming to PARRIS ISLAND, on average, how hard did you exercise running or jogging?

- 1 - Very leisurely, breathing easy, as during a slow walk
- 2 - Leisurely, breathing and effort slightly greater than slow walk
- 3 - Average, breathing increased but not uncomfortable
- 4 - Intense, breathing hard, have to 'push' to keep going
- 5 - Very intensely, breathing labored, difficult to keep going

8. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, what was the most number of miles you ran at any one time?

— — — miles.

9. During the LAST 2 MONTHS before coming to PARRIS ISLAND, how often did you exercise or play sports other than running or jogging? (circle one)

- 0 - Never (If you did not do sports even once, skip to question 13)
- 1 - 1 time or less per week
- 2 - 2 times per week
- 3 - 3 times per week
- 4 - 4 times per week
- 5 - 5 times per week
- 6 - 6 times per week
- 7 - 7 or more times per week

10. On days you exercised or participated in sports other than running/jogging, on average, how many minutes did you exercise or participate in sports?

— — — minutes (average) of exercise/sports other than running/jogging each time I exercised.

11. In the 2 MONTHS before coming to PARRIS ISLAND, on average, how hard did you exercise or participate in sports other than running/jogging?

- 1 - Very leisurely, breathing easy, as during a slow walk
- 2 - Leisurely, breathing and effort slightly greater than slow walk
- 3 - Average, breathing increased but not uncomfortable
- 4 - Intense - breathing hard, have to 'push' to keep going
- 5 - Very intensely, breathing labored, difficult to keep going

12. What were the three most common sports you participated in, other than running/jogging? Please write in "1" for the most frequent, "2" for the second most frequent and "3" for the third most frequent. Do not number more than three. Read all before answering.

- ☐ Aerobics
- ☐ Walking
- ☐ Basketball
- ☐ Football
- ☐ Soccer
- ☐ Rugby
- ☐ Baseball
- ☐ Softball
- ☐ Bicycling
- ☐ Swimming
- ☐ Tennis
- ☐ Rowing
- ☐ Shot put and/or discus throwing
- ☐ Roller blading
- ☐ Hockey
- ☐ Weight lifting
- ☐ Other sports _____

13. Compared to others your same age and sex, how would you describe your overall physical activity before reporting to PARRIS ISLAND? (circle one)

- 1 - Inactive
- 2 - Not very active
- 3 - Average
- 4 - Very active

14. How would you rate your physical fitness prior to coming to PARRIS ISLAND compared to others your same age and sex? (circle one answer)

- | | | | | |
|------|------|------|-----------|-----------|
| 1 | 2 | 3 | 4 | 5 |
| Poor | Fair | Good | Very good | Excellent |

15. Do you take any medications on a regular basis, including birth control pills? (circle one answer)

- 0 - No
- 1 - Yes, please list: _____

16. Have you ever been sick from the heat, for example, heat exhaustion, or heat stroke?

0 - No

1 - Yes: If yes, please specify what year, 19__.

What was the diagnosis? (circle one)

1 - heat exhaustion

2 - heat stroke

3 - other _____

M17. In the two months prior to reporting to Parris Island, did you work at a job that required hard labor?

0 - No (if no, stop)

1 - Yes

M18. For your hard labor job in the two months prior to reporting to Parris Island, how many hours per week was the work "very intense" hard labor. Very intense hard labor is where your breathing is hard and you have to 'push' to keep going.

_____ hours per week of very intense hard labor

M19. For your hard labor job in the two months prior to reporting to Parris Island, how many hours per week was the work "intense" hard labor. Intense hard labor is where your breathing is increased but not uncomfortable.

_____ hours per week of intense hard labor

M20. What hard labor job did you work at?

1. Farming

2. Furniture moving

3. Construction

4. Other _____

END OF ENROLLMENT

TEST ONE

MALE SKIN FOLDS	FIRST	SECOND	THIRD
Chest	_____	_____	_____
Abdomen	_____	_____	_____
Thigh	_____	_____	_____

1. Did you have any watch last night (circle all that apply)?
0 - No, I did not have any watch last night. If no, skip to question #3
1 - Yes, I had fire watch last night.
2 - Yes, I had guard mount watch last night.
2. What time did you have watch last night?
_____ to _____
Hour Hour
3. How many hours of sleep did you have last night?
_____ hours of sleep
4. How many canteens of water did you drink yesterday up until the time you went to bed?
_____ canteens
5. How many canteens of water did you drink last night, after lights out and before wake-up call this morning?
_____ canteens
6. How many canteens of water did you drink since wake-up this morning?
_____ number of canteens
7. In the last 24 hours, did you drink any water not from a canteen?
0 - No
1 - Yes If yes, estimate the number of glasses _____
8. How many glasses of juice, punch, or other drink (not water or milk) did you drink yesterday?
_____ number of glasses
9. How many glasses of juice, punch, or other drink (not water or milk) did you have with breakfast this morning?
_____ number of glasses
10. Did you go to sick call in the last two weeks? (circle one answer)
0 - No
1 - Yes, If yes, write diagnosis _____

11. Have you felt well in the last three days? (circle one answer)

0 - No If no, describe your symptoms and/or illness: _____

1 - ~~Yes~~

12. In the past 3 days, have you had a ...?

Cold	0-No	1-Yes
Sore Throat	0-No	1-Yes
Fever/Chills	0-No	1-Yes
Fainting	0-No	1-Yes
Nausea	0-No	1-Yes
Vomiting	0-No	1-Yes
Diarrhea	0-No	1-Yes
Constipation	0-No	1-Yes
Painful urination	0-No	1-Yes
Blood in urine	0-No	1-Yes
Strain/Sprain	0-No	1-Yes
Broken bone	0-No	1-Yes
Fast or irregular heart beat	0-No	1-Yes
Cellulitis (skin infection)	0-No	1-Yes
Sunburn, over more one third of body	0-No	1-Yes
Cut in skin longer than 2" and deeper than 1/8th inch	0-No	1-Yes

END TEST ONE

TEST TWO

MALE SKIN FOLDS	FIRST	SECOND	THIRD	WEIGHT
Chest	_____	_____	_____	_____ (kg)
Abdomen	_____	_____	_____	
Thigh	_____	_____	_____	

1. Did you have any watch last night (circle all that apply)?
 0 - No, I did not have any watch last night. If no, skip to question #3
 1 - Yes, I had fire watch last night.
 2 - Yes, I had guard mount watch last night.
2. What time did you have watch last night?
 _____ to _____
 Hour Hour
3. How many hours of sleep did you have last night?
 _____ hours of sleep
4. How many canteens of water did you drink yesterday up until the time you went to bed?
 _____ canteens
5. How many canteens of water did you drink last night, after lights out and before wake-up call this morning?
 _____ canteens
6. How many canteens of water did you drink since wake-up this morning?
 _____ number of canteens
7. In the last 24 hours, did you drink any water not from a canteen?
 0 - No
 1 - Yes If yes, estimate the number of glasses _____
8. How many glasses of juice, punch, or other drink (not water or milk) did you drink yesterday?
 _____ number of glasses
9. How many glasses of juice, punch, or other drink (not water or milk) did you have with breakfast this morning?
 _____ number of glasses
10. Did you go to sick call in the last two weeks? (circle one answer)
 0 - No
 1 - Yes, If yes, write diagnosis _____

11. Have you felt well in the last three days? (circle one answer)

0 - No If no, describe your symptoms and/or illness: _____

1 - ☒ Yes

12. In the past 3 days, have you had a ...?

Cold	0-No	1-Yes
Sore Throat	0-No	1-Yes
Fever/Chills	0-No	1-Yes
Fainting	0-No	1-Yes
Nausea	0-No	1-Yes
Vomiting	0-No	1-Yes
Diarrhea	0-No	1-Yes
Constipation	0-No	1-Yes
Painful urination	0-No	1-Yes
Blood in urine	0-No	1-Yes
Strain/Sprain	0-No	1-Yes
Broken bone	0-No	1-Yes
Fast or irregular heart beat	0-No	1-Yes
Cellulitis (skin infection)	0-No	1-Yes
Sunburn, over more one third of body	0-No	1-Yes
Cut in skin longer than 2" and deeper than 1/8th inch	0-No	1-Yes

END TEST TWO

TEST THREE

MALE SKIN FOLDS	FIRST	SECOND	THIRD	WEIGHT
Chest	_____	_____	_____	_____ (kg)
Abdomen	_____	_____	_____	
Thigh	_____	_____	_____	

1. Did you have any watch last night (circle all that apply)?
 0 - No, I did not have any watch last night. If no, skip to question #3
 1 - Yes, I had fire watch last night.
 2 - Yes, I had guard mount watch last night.
2. What time did you have watch last night?
 _____ to _____
 Hour Hour
3. How many hours of sleep did you have last night?
 _____ hours of sleep
4. How many canteens of water did you drink yesterday up until the time you went to bed?
 _____ canteens
5. How many canteens of water did you drink last night, after lights out and before wake-up call this morning?
 _____ canteens
6. How many canteens of water did you drink since wake-up this morning?
 _____ number of canteens
7. In the last 24 hours, did you drink any water not from a canteen?
 0 - No
 1 - Yes If yes, estimate the number of glasses _____
8. How many glasses of juice, punch, or other drink (not water or milk) did you drink yesterday?
 _____ number of glasses
9. How many glasses of juice, punch, or other drink (not water or milk) did you have with breakfast this morning?
 _____ number of glasses
10. Did you go to sick call in the last two weeks? (circle one answer)
 0 - No
 1 - Yes, If yes, write diagnosis _____

11. Have you felt well in the last three days? (circle one answer)

0 - No If no, describe your symptoms and/or illness: _____

1 - ~~Yes~~

12. In the past 3 days, have you had a ...?

Cold	0-No	1-Yes
Sore Throat	0-No	1-Yes
Fever/Chills	0-No	1-Yes
Fainting	0-No	1-Yes
Nausea	0-No	1-Yes
Vomiting	0-No	1-Yes
Diarrhea	0-No	1-Yes
Constipation	0-No	1-Yes
Painful urination	0-No	1-Yes
Blood in urine	0-No	1-Yes
Strain/Sprain	0-No	1-Yes
Broken bone	0-No	1-Yes
Fast or irregular heart beat	0-No	1-Yes
Cellulitis (skin infection)	0-No	1-Yes
Sunburn, over more one third of body	0-No	1-Yes
Cut in skin longer than 2" and deeper than 1/8th inch	0-No	1-Yes

END TEST THREE

TEST FOUR

MALE SKIN FOLDS	FIRST	SECOND	THIRD	WEIGHT
Chest	_____	_____	_____	_____ (kg)
Abdomen	_____	_____	_____	
Thigh	_____	_____	_____	

1. Did you have any watch last night (circle all that apply)?
 0 - No, I did not have any watch last night. If no, skip to question #3
 1 - Yes, I had fire watch last night.
 2 - Yes, I had guard mount watch last night.
2. What time did you have watch last night?
 _____ to _____
 Hour Hour
3. How many hours of sleep did you have last night?
 _____ hours of sleep
4. How many canteens of water did you drink yesterday up until the time you went to bed?
 _____ canteens
5. How many canteens of water did you drink last night, after lights out and before wake-up call this morning?
 _____ canteens
6. How many canteens of water did you drink since wake-up this morning?
 _____ number of canteens
7. In the last 24 hours, did you drink any water not from a canteen?
 0 - No
 1 - Yes If yes, estimate the number of glasses _____
8. How many glasses of juice, punch, or other drink (not water or milk) did you drink yesterday?
 _____ number of glasses
9. How many glasses of juice, punch, or other drink (not water or milk) did you have with breakfast this morning?
 _____ number of glasses
10. Did you go to sick call in the last two weeks? (circle one answer)
 0 - No
 1 - Yes, If yes, write diagnosis _____

11. Have you felt well in the last three days? (circle one answer)

0 - No If no, describe your symptoms and/or illness: _____

1 - Yes

12. In the past 3 days, have you had a ...?

Cold	0-No	1-Yes
Sore Throat	0-No	1-Yes
Fever/Chills	0-No	1-Yes
Fainting	0-No	1-Yes
Nausea	0-No	1-Yes
Vomiting	0-No	1-Yes
Diarrhea	0-No	1-Yes
Constipation	0-No	1-Yes
Painful urination	0-No	1-Yes
Blood in urine	0-No	1-Yes
Strain/Sprain	0-No	1-Yes
Broken bone	0-No	1-Yes
Fast or irregular heart beat	0-No	1-Yes
Cellulitis (skin infection)	0-No	1-Yes
Sunburn, over more one third of body	0-No	1-Yes
Cut in skin longer than 2" and deeper than 1/8th inch	0-No	1-Yes

END TEST FOUR

HEIGHT

(cm) WT

APPENDIX B4

(kg) 96F (8/05/96)

Privacy Act Statement

Authority: 5 U.S.C. 301; 10 U.S.C. 1071-1090; 44 C.S.C. 3101; E.O. 9397; DA PAM 25-51, Paragraph 14-4

Purpose and routine use: To help researchers analyze demographic and physiological data in connection with heat injuries in Marine recruits. Your name/ social security number is needed during the study to assure accuracy in matching your answers on this form to physiological measurements made on you. When data analysis is completed, your name/social security number will be removed from the questionnaires and the rest of the information that you provide on this form will remain part of the research file until it is eligible for destruction. Investigators responsible for the conduct of this study are at the U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts, 01760, and the Naval Hospital, Beaufort, South Carolina, 29902. Only these investigators and those working under their supervision will have access to the information that you provide. Information collected in this study will be treated as confidential to the extent permitted by applicable law. Reports regarding this study will not include individual names or other personal identifiers.

Disclosure: Personal information on this form is given on a voluntary basis. Failure to give an answer to any question on this questionnaire will not affect your right to participate in the remainder of this study.

READ ALL QUESTIONS CAREFULLY; ANSWER ALL QUESTIONS TO THE BEST OF YOUR RECOLLECTION BY CIRCLING THE APPROPRIATE ANSWER AND/OR FILLING IN THE BLANK

Last name: _____

First name: _____ Middle initial: _____

Social Security Number _____ - _____ - _____

Platoon number: _____

1. In the six months before reporting to PARRIS ISLAND, on average, how many cigarettes did you smoke per day?

0 - None, I did not smoke.

_____ cigarettes smoked per day. (There are 20 in a pack.)

2. How many years have you regularly smoked cigarettes?

0 - I have not regularly smoked cigarettes.

_____ years.

3. How many years have you regularly consumed one or more alcoholic drinks per week?

0 - None, I do not regularly drink alcohol.

_____ years

4. What is the maximum number of alcoholic drinks you have consumed per week on a regular basis? (one shot of whiskey, one glass of wine, and one 12 ounce beer each counts as one drink)

0 - None, I do not regularly drink alcohol.

_____ alcoholic drinks consumed per week on a regular basis

5. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, on average, how many times per week did you run or jog? (circle one)

0 - Never (If you did not run/jog even once, skip to question 9)

1 - 1 time or less per week

2 - 2 times per week

3 - 3 times per week

4 - 4 times per week

5 - 5 times per week

6 - 6 times per week

7 - 7 or more times per week

6. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, how much time did it usually take you to complete a single running or jogging workout?

— — — minutes

7. In the 2 MONTHS BEFORE coming to PARRIS ISLAND, on average, how hard did you exercise running or jogging?

- 1 - Very leisurely, breathing easy, as during a slow walk
- 2 - Leisurely, breathing and effort slightly greater than slow walk
- 3 - Average, breathing increased but not uncomfortable
- 4 - Intense, breathing hard, have to 'push' to keep going
- 5 - Very intensely, breathing labored, difficult to keep going

8. During the 2 MONTHS BEFORE coming to PARRIS ISLAND, what was the most number of miles you ran at any one time?

_____ miles.

9. During the LAST 2 MONTHS before coming to PARRIS ISLAND, how often did you exercise or play sports other than running or jogging? (circle one)

- 0 - Never (If you did not do sports even once, skip to question 13)
- 1 - 1 time or less per week
- 2 - 2 times per week
- 3 - 3 times per week
- 4 - 4 times per week
- 5 - 5 times per week
- 6 - 6 times per week
- 7 - 7 or more times per week

10. On days you exercised or participated in sports other than running/jogging, on average, how many minutes did you exercise or participate in sports?

_____ minutes (average) of exercise/sports other than running/jogging each time I exercised.

11. In the 2 MONTHS before coming to PARRIS ISLAND, on average, how hard did you exercise or participate in sports other than running/jogging?

- 1 - Very leisurely, breathing easy, as during a slow walk
- 2 - Leisurely, breathing and effort slightly greater than slow walk
- 3 - Average, breathing increased but not uncomfortable
- 4 - Intense - breathing hard, have to 'push' to keep going
- 5 - Very intensely, breathing labored, difficult to keep going

12. What were the three most common sports you participated in, other than running/jogging? Please write in "1" for the most frequent, "2" for the second most frequent and "3" for the third most frequent. Do not number more than three. Read all before answering.

- ☐ \ Aerobics
- ☐ Walking
- ☐ Basketball
- ☐ Football
- ☐ Soccer
- ☐ Rugby
- ☐ Baseball
- ☐ Softball
- ☐ Bicycling
- ☐ Swimming
- ☐ Tennis
- ☐ Rowing
- ☐ Shot put and/or discus throwing
- ☐ Roller blading
- ☐ Hockey
- ☐ Weight lifting
- ☐ Other sports _____

13. Compared to others your same age and sex, how would you describe your overall physical activity before reporting to PARRIS ISLAND? (circle one)

- 1 - Inactive
- 2 - Not very active
- 3 - Average
- 4 - Very active

14. How would you rate your physical fitness prior to coming to PARRIS ISLAND compared to others your same age and sex? (circle one answer)

- | | | | | |
|------|------|------|-----------|-----------|
| 1 | 2 | 3 | 4 | 5 |
| Poor | Fair | Good | Very good | Excellent |

15. Do you take any medications on a regular basis, including birth control pills? (circle one answer)

- 0 - No
- 1 - Yes, please list: _____

16. Have you ever been sick from the heat, for example, heat exhaustion, or heat stroke?

0 - No

1 - Yes: If yes, please specify what year, 19__.

What was the diagnosis? (circle one)

1 - heat exhaustion

2 - heat stroke

3 - other _____

F17. At what age did you start to menstruate (have periods)?

0 - No - circle no, if you have not started menstruation.

__ __ years old

F18. How many periods did you have during the last 12 months? (circle one)

1 - {10 to 12 periods}

2 - {7 to 9 periods}

3 - {5 to 6 periods}

4 - {1 to 4 periods}

5 - {No periods}

F19. In the last 12 months, how long was your usual menstrual cycle (from the start of one period until the start of the next period)? (For most women, a cycle is 25-35 days).

__ __ days

F20. When you had a period during the last 12 months, how many days did the flow usually last? (For most women, the flow usually lasts 2-5 days.)

__ __ days

F21. In the last 12 months, have your menstrual periods been irregular?

0 - No

1 - Yes

F22. In the last 12 months, have you gone more than six months between any menstrual periods (other than for pregnancy)?

0 - No

1 - Yes

F23. During the last 12 months, did you ever use any hormonal therapy to regulate your menstrual cycle or did you ever use birth control pills?

0 - No

1 - Yes

F24. Have you been pregnant during the last 12 months?

0 - No

1 - Yes **END OF ENROLLMENT**

TEST ONE

FEMALE SKIN FOLDS	FIRST	SECOND	THIRD
Triceps	_____	_____	_____
Suprailiac	_____	_____	_____
Thigh	_____	_____	_____

1. Did you have any watch last night (circle all that apply)?
0 - No, I did not have any watch last night. If no, skip to question #3
1 - Yes, I had fire watch last night.
2 - Yes, I had guard mount watch last night.
2. What time did you have watch last night?
_____ to _____
Hour Hour
3. How many hours of sleep did you have last night?
_____ hours of sleep
4. How many canteens of water did you drink yesterday up until the time you went to bed?
_____ canteens
5. How many canteens of water did you drink last night, after lights out and before wake-up call this morning?
_____ canteens
6. How many canteens of water did you drink since wake-up this morning?
_____ number of canteens
7. In the last 24 hours, did you drink any water not from a canteen?
0 - No
1 - Yes If yes, estimate the number of glasses _____
8. How many glasses of juice, punch, or other drink (not water or milk) did you drink yesterday?
_____ number of glasses
9. How many glasses of juice, punch, or other drink (not water or milk) did you have with breakfast this morning?
_____ number of glasses
10. Did you go to sick call in the last two weeks? (circle one answer)
0 - No
1 - Yes, If yes, write diagnosis _____

11. Have you felt well in the last three days? (circle one answer)

0 - No If no, describe your symptoms and/or illness: _____

1 - Yes

12. In the past 3 days, have you had a ...?

Cold	0-No	1-Yes
Sore Throat	0-No	1-Yes
Fever/Chills	0-No	1-Yes
Fainting	0-No	1-Yes
Nausea	0-No	1-Yes
Vomiting	0-No	1-Yes
Diarrhea	0-No	1-Yes
Constipation	0-No	1-Yes
Painful urination	0-No	1-Yes
Blood in urine	0-No	1-Yes
Strain/Sprain	0-No	1-Yes
Broken bone	0-No	1-Yes
Fast or irregular heart beat	0-No	1-Yes
Cellulitis (skin infection)	0-No	1-Yes
Sunburn, over more one third of body	0-No	1-Yes
Cut in skin longer than 2" and deeper than 1/8th inch	0-No	1-Yes

13. On the 1996 calendar below, circle the date of the start of bleeding for your last menstrual period.

TODAY'S DATE IS _____ [provided by research team]

If your last menstrual period started before January 1, 1996, check the box above the month of January.

☐ Started before January 1, 1996

1996

JANUARY							FEBRUARY							MARCH							APRIL						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
	1	2	3	4	5	6				1	2	3					1	2			1	2	3	4	5	6	
7	8	9	10	11	12	13	4	5	6	7	8	9	10	3	4	5	6	7	8	9	7	8	9	10	11	12	13
14	15	16	17	18	19	20	11	12	13	14	15	16	17	10	11	12	13	14	15	16	14	15	16	17	18	19	20
21	22	23	24	25	26	27	18	19	20	21	22	23	24	17	18	19	20	21	22	23	21	22	23	24	25	26	27
28	29	30	31	25	26	27	28	29	24	25	26	27	28	29	30	28	29	30									

MAY							JUNE							JULY							AUGUST						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
			1	2	3	4						1		1	2	3	4	5	6					1	2	3	
5	6	7	8	9	10	11	2	3	4	5	6	7	8	7	8	9	10	11	12	13	4	5	6	7	8	9	10
12	13	14	15	16	17	18	9	10	11	12	13	14	15	14	15	16	17	18	19	20	11	12	13	14	15	16	17
19	20	21	22	23	24	25	16	17	18	19	20	21	22	21	22	23	24	25	26	27	18	19	20	21	22	23	24
26	27	28	29	30	31	23	24	25	26	27	28	29	28	29	30	31	25	26	27	28	29	30	31				

SEPTEMBER							OCTOBER							NOVEMBER							DECEMBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
1	2	3	4	5	6	7			1	2	3	4	5					1	2	1	2	3	4	5	6	7	
8	9	10	11	12	13	14	6	7	8	9	10	11	12	3	4	5	6	7	8	9	8	9	10	11	12	13	14
15	16	17	18	19	20	21	13	14	15	16	17	18	19	10	11	12	13	14	15	16	15	16	17	18	19	20	21
22	23	24	25	26	27	28	20	21	22	23	24	25	26	17	18	19	20	21	22	23	22	23	24	25	26	27	28
29	30	27	28	29	30	31	24	25	26	27	28	29	30	29	30	31											

END TEST ONE

TEST TWO

FEMALE SKIN FOLDS	FIRST	SECOND	THIRD	WEIGHT
Triceps	_____	_____	_____	_____ (KG)
Suprailiac	_____	_____	_____	
Thigh	_____	_____	_____	

1. Did you have any watch last night (circle all that apply)?
 0 - No, I did not have any watch last night. If no, skip to question #3
 1 - Yes, I had fire watch last night.
 2 - Yes, I had guard mount watch last night.
2. What time did you have watch last night?
 _____ to _____
 Hour Hour
3. How many hours of sleep did you have last night?
 _____ hours of sleep
4. How many canteens of water did you drink yesterday up until the time you went to bed?
 _____ canteens
5. How many canteens of water did you drink last night, after lights out and before wake-up call this morning?
 _____ canteens
6. How many canteens of water did you drink since wake-up this morning?
 _____ number of canteens
7. In the last 24 hours, did you drink any water not from a canteen?
 0 - No
 1 - Yes If yes, estimate the number of glasses _____
8. How many glasses of juice, punch, or other drink (not water or milk) did you drink yesterday?
 _____ number of glasses
9. How many glasses of juice, punch, or other drink (not water or milk) did you have with breakfast this morning?
 _____ number of glasses
10. Did you go to sick call in the last two weeks? (circle one answer)
 0 - No
 1 - Yes, If yes, write diagnosis _____

11. Have you felt well in the last three days? (circle one answer)

0 - No If no, describe your symptoms and/or illness: _____

1 - ~~No~~ Yes

12. In the past 3 days, have you had a ...?

Cold	0-No	1-Yes
Sore Throat	0-No	1-Yes
Fever/Chills	0-No	1-Yes
Fainting	0-No	1-Yes
Nausea	0-No	1-Yes
Vomiting	0-No	1-Yes
Diarrhea	0-No	1-Yes
Constipation	0-No	1-Yes
Painful urination	0-No	1-Yes
Blood in urine	0-No	1-Yes
Strain/Sprain	0-No	1-Yes
Broken bone	0-No	1-Yes
Fast or irregular heart beat	0-No	1-Yes
Cellulitis (skin infection)	0-No	1-Yes
Sunburn, over more one third of body	0-No	1-Yes
Cut in skin longer than 2" and deeper than 1/8th inch	0-No	1-Yes

13. On the 1996 calendar below, circle the date of the start of bleeding for your last menstrual period.

TODAY'S DATE IS _____ (provided by research team)

If your last menstrual period started before January 1, 1996, check the box above the month of January.

☐ Started before January 1, 1996

1996

JANUARY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	FEBRUARY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	MARCH S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	APRIL S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
MAY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	JUNE S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	JULY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	AUGUST S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
SEPTEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	OCTOBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	NOVEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	DECEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

END TEST TWO

TEST THREE

FEMALE SKIN FOLDS	FIRST	SECOND	THIRD	WEIGHT
Triceps	_____	_____	_____	_____ (KG)
Suprailiac	_____	_____	_____	
Thigh	_____	_____	_____	

1. Did you have any watch last night (circle all that apply)?
0 - No, I did not have any watch last night. If no, skip to question #3
1 - Yes, I had fire watch last night.
2 - Yes, I had guard mount watch last night.
2. What time did you have watch last night?
_____ to _____
Hour Hour
3. How many hours of sleep did you have last night?
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4. How many canteens of water did you drink yesterday up until the time you went to bed?
_____ canteens
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_____ canteens
6. How many canteens of water did you drink since wake-up this morning?
_____ number of canteens
7. In the last 24 hours, did you drink any water not from a canteen?
0 - No
1 - Yes If yes, estimate the number of glasses _____
8. How many glasses of juice, punch, or other drink (not water or milk) did you drink yesterday?
_____ number of glasses
9. How many glasses of juice, punch, or other drink (not water or milk) did you have with breakfast this morning?
_____ number of glasses
10. Did you go to sick call in the last two weeks? (circle one answer)
0 - No
1 - Yes, If yes, write diagnosis _____

11. Have you felt well in the last three days? (circle one answer)

0 - No If no, describe your symptoms and/or illness: _____

1 - ~~Yes~~

12. In the past 3 days, have you had a ...?

Cold	0-No	1-Yes
Sore Throat	0-No	1-Yes
Fever/Chills	0-No	1-Yes
Fainting	0-No	1-Yes
Nausea	0-No	1-Yes
Vomiting	0-No	1-Yes
Diarrhea	0-No	1-Yes
Constipation	0-No	1-Yes
Painful urination	0-No	1-Yes
Blood in urine	0-No	1-Yes
Strain/Sprain	0-No	1-Yes
Broken bone	0-No	1-Yes
Fast or irregular heart beat	0-No	1-Yes
Cellulitis (skin infection)	0-No	1-Yes
Sunburn, over more one third of body	0-No	1-Yes
Cut in skin longer than 2" and deeper than 1/8th inch	0-No	1-Yes

13. On the 1996 calendar below, circle the date of the start of bleeding for your last menstrual period.

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If your last menstrual period started before January 1, 1996, check the box above the month of January.

☐ Started before January 1, 1996

1996

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END TEST THREE

TEST FOUR

FEMALE SKIN FOLDS	FIRST	SECOND	THIRD	WEIGHT
Triceps	_____	_____	_____	_____ (KG)
Suprailiac	_____	_____	_____	
Thigh	_____	_____	_____	

1. Did you have any watch last night (circle all that apply)?
 0 - No, I did not have any watch last night. If no, skip to question #3
 1 - Yes, I had fire watch last night.
 2 - Yes, I had guard mount watch last night.
2. What time did you have watch last night?
 _____ to _____
 Hour Hour
3. How many hours of sleep did you have last night?
 _____ hours of sleep
4. How many canteens of water did you drink yesterday up until the time you went to bed?
 _____ canteens
5. How many canteens of water did you drink last night, after lights out and before wake-up call this morning?
 _____ canteens
6. How many canteens of water did you drink since wake-up this morning?
 _____ number of canteens
7. In the last 24 hours, did you drink any water not from a canteen?
 0 - No
 1 - Yes If yes, estimate the number of glasses _____
8. How many glasses of juice, punch, or other drink (not water or milk) did you drink yesterday?
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9. How many glasses of juice, punch, or other drink (not water or milk) did you have with breakfast this morning?
 _____ number of glasses
10. Did you go to sick call in the last two weeks? (circle one answer)
 0 - No
 1 - Yes, If yes, write diagnosis _____

11. Have you felt well in the last three days? (circle one answer)

0 - No If no, describe your symptoms and/or illness: _____

1 - ~~Yes~~

12. In the past 3 days, have you had a ...?

Cold	0-No	1-Yes
Sore Throat	0-No	1-Yes
Fever/Chills	0-No	1-Yes
Fainting	0-No	1-Yes
Nausea	0-No	1-Yes
Vomiting	0-No	1-Yes
Diarrhea	0-No	1-Yes
Constipation	0-No	1-Yes
Painful urination	0-No	1-Yes
Blood in urine	0-No	1-Yes
Strain/Sprain	0-No	1-Yes
Broken bone	0-No	1-Yes
Fast or irregular heart beat	0-No	1-Yes
Cellulitis (skin infection)	0-No	1-Yes
Sunburn, over more one third of body	0-No	1-Yes
Cut in skin longer than 2" and deeper than 1/8th inch	0-No	1-Yes

13. On the 1996 calendar below, circle the date of the start of bleeding for your last menstrual period.

TODAY'S DATE IS _____, (provided by research team)

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1996

JANUARY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	FEBRUARY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	MARCH S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	APRIL S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
MAY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	JUNE S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	JULY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	AUGUST S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
SEPTEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	OCTOBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	NOVEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	DECEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

END TEST FOUR